Benton Foothills Watershed Analysis Area

Marys Peak Resource Area
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The analysis portion of this project was conducted from Fall 1996 through Spring 1997. A first production of this document was completed in August 1997. The analysis generally follows the federal guide for watershed analysis (Version. 2.2, August 95) although some modifications were made such as combining chapters to reduce redundancies. This is a document which is still evolving and will be updated as new information becomes available. The data in this document was the best available; though in some cases there was little relevant data available. Management opportunities for this analysis area must be considered in light of the checkerboard land ownership pattern of BLM-administered lands. Cooperative programs with adjacent ownerships are necessary to achieve optimum results in restoration opportunities for this analysis area. No warranty is made as to the accuracy, reliability or completeness of the data or maps contained herein. This document was done in cooperation with the U.S. Fish & Wildlife Service.

Table of Contents

List of Figures and Tables

EXECUTIVE SUMMARY

The Benton Foothills watershed analysis area (hereinafter referred to as the analysis area), located in the Upper Willamette River Basin, encompasses about 80,647 acres of the Coast Range foothills and western edge of the Willamette Valley, south Benton County (Figure 1). To the north of the analysis area is Highway 34, and to the east is Highway 99W. About eight percent of the analysis area (6,149 acres) is under Bureau of Land Management (BLM) management. William L. Finley National Wildlife Refuge totals 5,325 acres (7 percent), and the remaining land is in private ownership. The communities of Bellfountain, Dawson, Glenbrook, and Alpine are located within the analysis area boundaries.

The uplands are primarily forested areas in federal ownership or private industrial forest ownership. The lowlands are mainly agricultural lands including field crops and orchards, Christmas tree plantations, and pasture, interspersed with remnant oak/savannah habitat.

The analysis area is part of the fifth-field Marys River Watershed. Small streams in the analysis area flow into Muddy Creek and Greasy Creek, and then to Marys River. Lands in the headwaters of Greasy Creek are included in the analysis area as they are the only other remaining BLM land in the Marys River Watershed not covered by watershed analysis (approximately 720 acres total), and they are similar in character to this area.

The Siuslaw National Forest has scheduled first iteration analysis of the Marys River Watershed for Fiscal Year 1999. The BLM Marys Peak Resource Area priority for analysis is Fiscal Year 1997. A large percentage of the resource area Matrix allocation (primary timber management area) is in the south part of the Marys River Watershed. Timely watershed analysis is needed to provide an ecosystem framework for future management proposals. The Marys Peak Resource Area and Siuslaw National Forest managers discussed and reached agreement to accelerate analysis of a portion of the Marys River Watershed (i.e., the Benton Foothills Watershed Analysis Area). This allows BLM immediate priority for analysis. The results of the partial watershed analysis will be incorporated in the full analysis in Fiscal Year 1999.

The Benton Foothills analysis focuses on the uplands with limited projection on the lowlands, agricultural lands, and the William L. Finley Wildlife Refuge.

The topography of the analysis area is generally moderate. There are small inclusions of steep to very steep sloping lands primarily along the western edge of the analysis area. Rainfall varies from about 40 inches on the Willamette Valley floor to about 70 inches at the higher elevations. Plant communities and biomass production also vary from warm, dry sites below 1,000 feet to moist sites at higher elevations.

Fire history, settlement with associated farming and pasturing, and past timber management practices are the major factors affecting ecosystem dynamics in this analysis area. Absence of wildfire and burning for pasturage, abandonment of homesteads, natural encroachment of forest into open areas, and establishment of conifer plantations have advanced the eastern edge of the forest approximately three to four miles into the lower foothills and valley.

Due to drier conditions, the analysis area historically supported less late-successional forest than interior Coast Range watersheds. Early maps indicate 20 to 40% of the analysis area may have been in late-successional forest. Currently, forests less than 80 years-old account for 35% of the analysis area; old-growth represents approximately 5%. For BLM-administered lands in late-successional forest: 50-70 year-old conifers are the dominant type (47%) followed by 10-40 year-old conifers (22.7%), 50+ year-old mixed stands (8.7%), and 50+ year-old hardwoods (7%).

Riparian reserves constitute approximately 43% of the BLM- managed land. Seventy-eight percent of the riparian reserves are composed of conifer stands less than 80-years old, and hardwoods make up 16%. Existing coarse woody debris is in older decay classes. Most of the streams flow in channels of unconsolidated sands and silts, therefore riparian vegetation is key to maintenance of channel form and function.

Resident fish are present in the analysis area; there are no anadromous fish species. Oregon chub, a Threatened and Endangered species, is found in the analysis area. No habitat or population is found on BLM-managed lands, but the headwaters of some tributaries to Gray Creek are located on BLM.

There are approximately 80 acres of suitable nesting habitat for marbled murrelets; no marbled murrelets have been detected to date during past surveys. A 100-acre core area is reserved in Late- Successional Reserve lands for a recognized northern spotted owl site.

The analysis identifies issues and key questions, evaluates reference and current conditions, and addresses findings and recommendations which meet management objectives outlined in the *Salem District Resource Management Plan* (RMP) and ensure continued health of forest ecosystems. The following table summarizes some of these factors.

Management Summary for Benton Foothills Analysis Area

Issue	Findings	Recommendations
Soil Productivity: 1) Soil Compaction and Displacement	1) Ground-based tractor logging has occurred on approximately 5,900 acres of forested uplands, resulting in about 1,530 acres of soil compaction.	C Reduce areas of existing soil compaction, especially those areas that are non-vegetated and/or contributing to off-site stream impacts. C Reduce road densities, where possible, especially those impacting streams and contributing to off-site impacts. C Where possible, avoid stream disturbing activities and heavy hauling during rainy periods when high runoff is occurring. C Where possible, avoid practices that remove surface vegetation cover, soil litter and duff. C Mitigate any new soil compaction, especially where the compaction connects to roads or streams.
	2) Indications of past or present instability in an area covering approximately 6 square miles southeast of Flat Mountain.	C Update Timber Production Capability Classification (TPCC) mapping early in the project planning stage and before implementation. C Avoid road construction methods that divert intercepted subsurface and surface water onto unstable or potentially unstable areas. C Where possible, avoid road and landing construction that under cut lower portion (toe) of slump areas.

Issue	Findings	Recommendations
		C Removal of trees will decrease the amount of evapotranspiration and increase the amount of late-season soil moisture and/or run-off by 20 to 24 inches during the growing season. Timber harvest should be avoided in highly unstable areas (see RMP, TPCC criteria and Best Management Practices (BMP) for additional management direction).
2) Erosional Processes	1) Historically, landslide frequency has been low. Although harvest activities are expected to increase due to the land use allocation, significant increases in land sliding rates are not expected.	C Apply practices that reduce the amount of surface runoff from roads and landings that directly enter streams: a. Redistribute intercepted subsurface flows back on the hillslopes. b. Mitigate areas of soil compaction that are contributing surface runoff to streams. C Avoid tree removal on high landslide hazard stream adjacent slopes and headwalls. C By avoiding activities in highly unstable areas and diverting water away from road fills, sediment discharge into streams will be greatly reduced.
	2) Surface erosion by water and dry-raveling is a natural process on hillslopes with gradients in excess of 60%. Surface erosion is accelerated when low growing ground cover and/or duff layer are removed. Thinning, regeneration harvest, and spring burning for site preparation leave the majority of the soil surface protected or undisturbed.	C Conduct operations to minimize soil and litter disturbance. Any operations that expose mineral soil, especially adjacent to roads and streams, should include plans to restore vegetation cover or divert water away from streams.

Issue	Findings	Recommendations
	3) GIS data shows no lands steeper than 90% in the watershed. However there are approximately 40 acres with slopes at or above 90% in T.13S., R.6W., Section 7, that have been identified in the field. These acres have been removed from the production base. With further investigations, more lands may be identified with TPCC restrictions for use.	C As new information is obtained continue to up-date land use maps with most accurate data to comply with TPCC system.
Vegetation: 1) Vegetation Management	1) The fifth field Marys River Watershed encompasses 5,444 acres of federal forests over 80 years of age in Late-Successional and Riparian Reserves (486 acres of BLM-administered land and 4,958 acres of U.S. Forest Service land). These acres are approximately 35 percent of the total federal forested acres in the watershed. Of the total acres, at least 3,527 acres are in excess of 120 years of age, comprising 23 percent of the watershed. Since the 15-percent rule is met in the Marys River Watershed in Reserves, older forest stands in the analysis area Matrix do not need to be reserved. 2) Late-successional forest (80 years and older) comprises about 503 acres in the analysis area. By the year 2030 (approximately), this amount should increase by an additional 376 acres in LSR and about 1,300 acres in Riparian Reserves.	C Work with USFS to map stands contributing to the 15 percent rule. C Thoroughly inventory forests within Riparian Reserves to confirm estimates on late-successional forest trajectories. C Conduct exams in a selected sample of these stands to determine structural characteristics that would provide goals for management of younger-aged stands. C Conduct conifer releases in areas with dense red alders.

Issue	Findings	Recommendations
	3) 5,773 acres of stands occur on Matrix lands	C Identify and mark green trees for snags

Issue	Findings	Recommendations
2) Special Status Plants	1) Survey and manage species known to occur in the analysis area (primarily Reese Creek subwatershed) include fifteen fungi and eleven lichens.	C Manage habitat for these species according to Salem District RMP. C Continue surveys for special attention plant species; record and store locations in a database; and eventually develop a GIS layer.
3) Special Plant Communities	An estimated 39.5 acres (plus an additional 40 acres of shallow soil areas which may provide some important plant habitat) of special vegetation types (e.g., seasonal and permanent wetlands, open water areas, natural brushy openings) occur on BLM-administered lands within the analysis area. Special vegetation types on private lands (primarily on agricultural lands on the valley floor) also contribute about 465 acres of wetland-marsh; 6,295 acres wetland - riparian with trees; and 298 acres of open water.	C Maintain and/or enhance existing special vegetation types in order to provide diverse habitats. C Consider preparing a prescribed fire research plan to learn more about control of brushy and/or competing non-native species in small, selected areas where such treatment may be necessary. C Inventory to determine amount, location and size of special vegetation areas.
Riparian Reserves:	1) BLM Riparian Reserves in the analysis area lack older forest characteristics. Approximately 1,636 acres (78%) of the Riparian Reserves are in early and mid seral age stands, between ages 20 and 70. Many of these stands tend to be overstocked, and lack vertical structure. Stand exams have been done on approximately 800 acres in the Riparian Reserves.	C Following guidelines in Table 12, consider the above stands for density management treatments. C Inventory other stands between ages 20 and 70 to determine if they are developing older forest characteristics, and if they would benefit from density management or some other treatment to maintain or restore Aquatic Conservation Strategy (ACS) objectives.

Issue	Findings	Recommendations
	2) 16% of the BLM Riparian Reserves are in hardwood dominated stands. Many of these acres are narrow strips along streams which pose no barrier to LWD recruitment, stream shading, or development of older forest characteristics. Others occur on relatively broad flood plains with high water tables, where conifer stands do not naturally develop. There are other areas where there may be opportunities for restoration/enhancement projects.	C Following the guidelines in Table 12, the following reaches should be examined for enhancement opportunities: 1) Oliver Creek in T.14S., R.6W., Sec.5: Release western red cedar, possibly underplant western red cedar in some spots. 2) Oliver Creek in T.13S., R.6W., Sec.31: Replace hardwoods with conifers. 3) Green Peak in T.14S., R.6W., Sec.7: Release western red cedar and western hemlock. 4)Horse Pasture in T.13S., R.6W., Sec.25: Release conifers.
	3) There have been no data collected from stands over age 80 in the Riparian Reserves. Some may be developing older forest characteristics and may be able to serve as reference riparian stands.	C Inventory stands over age 80, looking at stands along lower gradient streams first. C Inventory Forest Peak Area of Critical Environmental Concern to determine if it would be suitable to use as a reference reach.
	4) Coarse woody debris (CWD), or down wood and snags, are an important component of the Riparian Reserves. Informal reconnaissance in the analysis area indicates that there is generally a sufficient amount of CWD in decay classes three through five, but no formal data exists. Stand exams done to date do not provide sufficient data.	C Inventory down wood and snags in the Riparian Reserves. C Using Table 11), design management activities in the Riparian Reserves to provide for down wood and snags in all decay classes over the life of the stand.

Issue	Findings	Recommendations
	5) Management activities in the Riparian Reserves can be used to promote older forest characteristics, attain ACS objectives and move the Riparian Reserves on a trajectory toward older forest characteristics. Desired riparian characteristics (see Appendix 8) include: C Diverse vegetation appropriate to the water table, geomorphic land type and stream channel type; C Diverse age classes (multi-layered canopy); C Mature conifers where they have occurred in the past; C Dead standing/down wood; C Stream connected to its flood plain (flood plain inundated every 1-3 years); C Stream bank vegetation with adequate root strength to maintain bank stability.	C Use Table 12 as a guide when considering management activities in the Riparian Reserves. Management Priorities: 1) Areas of connectivity to adjacent watersheds. 2) Riparian areas where inchannel improvement is planned or has been completed. 3) Areas adjacent to private lands. 4) Areas where other timber management is planned. C Other Management Activities in the Riparian Reserves a) Fire: Prescribed fire can be used at any age to achieve management objectives within the guidelines of the RMP. b) Special Forest Products: The guidelines set out in the District EA will be followed in the Riparian Reserves. c) Salvage: C The RMP will be followed, and logs will only be salvaged if required to attain ACS objectives. C Coarse woody debris will be left on the site to meet the goals in Table 11. C A site specific analysis will be done by an interdisciplinary team. C If salvage is required, yarding will be from existing roads.

Issue	Findings	Recommendations
Hydrology:	1) Precipitation, streamflow and peak flow events are approximately half the magnitude of those occurring just west of the drainage divide in the Alsea watershed. Additionally, rain-on -snow events are limited to small areas of Flat Mountain on the forested uplands of Beaver and Reese Creeks.	C Environmental assessments of proposed projects should identify the proportion of project area in transient snow zone (TSZ). Minimize additional permanent road construction in these areas and time projects to maintain low proportion of TSZ areas in 0-10 year age classes. Consider decommissioning roads and trails in these areas, particularly on unstable sites.
	2) Land management practices have likely altered hydrologic processes in the watershed from reference condition. Ground based harvesting systems and road construction have historically been the greatest contributor to these "cumulative effects" to hydrologic processes in the forested uplands. Trends have likely been partial recovery towards a new equilibrium somewhat degraded from reference conditions.	C Preferentially use aerial and cable-based harvesting systems. Reduce road surface area and locate new road construction on ridge tops, where possible. Roads that are not necessary for long-term stand management should be decommissioned after use. C For new road construction, implement RMP Management Actions/Direction (p. 62) including: C minimize road and landings locations in Riparian Reserves; C minimize disruption of natural hydrologic flowpaths, including diversion of streamflow and interception of surface and subsurface flow; C avoid wetlands entirely when constructing new roads.
	3) Reduced summer base flows coinciding with high demand and use of surface water are likely to be a limiting factor for water quality and surface water beneficial uses (i.e., aquatic function, domestic water, recreation, livestock, etc.) particularly in the lowland agricultural portions of the watershed.	

Issue	Findings	Recommendations
Stream Channel:	1) Land management practices have altered stream channel form and function in the watershed from reference condition. These alterations have contributed to the degradation of water quality and aquatic habitat.	C Roads that cross stream channels currently utilized by beaver, particularly dammed areas, should be identified. Road maintenance at these sites, including dam removal or destruction, should not proceed without approval by the fisheries biologist, wildlife biologist, hydrologist or road engineering staff in the Marys Peak Resource Area. C Harvest planning should consider the potential for falling or placing conifer in the stream channels to improve channel function and aquatic habitat. C Conduct in-stream inventory of all low gradient reaches on the BLM to determine functional condition.
Water Quality:	1) Water quality in the watershed is probably moderately to highly degraded from reference condition. However, there is not enough data to verify this. The following four parameters are of the greatest concern for maintenance of Water quality for aquatic function, domestic use, livestock, and recreation: C Suspended sediment and turbidity during much of the winter, particularly in the agricultural lowlands (data is available which supports this). Trend is for continued high levels, particularly of fines, due to bank erosion, surface erosion from agriculture, forest roads and trails, and “natural” background sources;	

Issue	Findings	Recommendations
	C Stream temperature and dissolved oxygen during summer base flow, particularly in the agricultural lowlands (some data available, not enough to verify this). Trend is for maintenance of stream temperatures and dissolved oxygen in the forested uplands, trends in the lowlands are unknown; and, C Coliform bacteria, possibly other infectious microorganisms, particularly in the agricultural lowlands during summer base flow (some data available, not enough to verify this). The trend is for this to continue unless actions are taken to protect surface water from livestock, increase base flow, and increase vegetative cover in riparian zones in these areas. 2) Reese Creek, Beaver Creek, and mainstem Muddy Creek appear to have the poorest water quality conditions overall. 3) Water quality conditions in the forested uplands appear to be generally good, but there is little data to verify this. The parameter of greatest concern is turbidity and suspended sediment, particularly chronic inputs of fine sediments from road and trail surfaces. 4) The overall basin trend is for increasing pollutant levels, particularly from rural development in the lowlands, with the potential for even greater degradation of water quality and impacts to beneficial uses.	C Monitor stream temperatures in the summer of 1997 below Super Hammer thinning.
Fish Species and Habitat:	1) Oregon chub, an Endangered Species Act listed species, occur in the analysis area in the Upper Muddy Creek sub-basin. Oregon chub habitat does not occur on BLM-managed land.	C BLM will follow RMP guidance for Aquatic Conservation Strategy until the Oregon chub Recovery Plan is completed; the recovery plan would then be implemented.

Issue	Findings	Recommendations
		C Road no. 13-6-25 is not critical for access needs; closure would minimize potential for risk to chub habitat on lands downstream of the headwaters.
	2) Fish presence occurs within 239 miles of stream in the analysis area; BLM manages 21.2 miles. Fish habitat surveys are completed on 9.5 miles on BLM.	C Complete habitat surveys on BLM lands. Work with other agencies, industries, and private land owners to gain missing data.
	3) Habitat data are limited on public and private lands. Data to establish overall habitat condition for the analysis area are not available.	C Fill data gaps. Where little or no data exists, recommendations should be made at the project level.
	4) Surveys indicate streams are not properly functioning in terms of large woody debris, pool area and pool quality on BLM lands.	C When management activities occur that involve tree falling in riparian areas near streams, fall trees into the stream. All activities conducted by BLM should be mitigated to prevent degradation to the stream channel as recommended by the RMP and ROD (BMP and Aquatic Conservation Strategy).
Wildlife Species and Habitat:	1) The analysis area has been converted from an oak-savannah habitat type in the lowlands and a late-seral forest in the uplands into a younger-aged Douglas-fir dominated forest.	C Protect existing, dry oak sites to provide habitat for those species associated with this habitat. Reserve scattered old growth trees and large downed wood within harvest units.
	2) One spotted owl pair is nesting in the Benton Foothills analysis area. Species that require large amounts of late seral and old growth habitat were probably never abundant within this analysis area.	C Thin LSR and Riparian Reserves to accelerate older forest habitat within the analysis area. Protect existing remnant old-growth component.
	3) The analysis area has little remaining late-seral and old-growth habitat.	C At a minimum, leave one-half of the reserve trees on every regeneration harvest area scattered across the unit.
	4) Dispersal by highly mobile species and habitat to allow dispersal to adjacent areas is not a significant issue within the analysis area.	C Retain connective dispersal habitat in Riparian Reserves.

Issue	Findings	Recommendations
	5) Special habitats appear to be a relatively minor component within the analysis area with the exception of some small wetlands. 6) There is one known sites for a special attention species (red tree vole) within the analysis area.	C Protect existing wetlands. C Actively survey areas that appear to contain habitat for special attention species.
Human Uses: 1) Commodity Forest Products	1) Sold or planned regeneration timber harvest in the analysis area fulfills approximately *68% of the resource area decadal commitment. **The decadal annual sale quantity from this analysis area is estimated to be approximately 30 percent. Annual sale quantity estimates the allowable harvest levels that could be maintained over the long term. One regeneration sale in the 60 year age class and a replacement volume sale account for the inflated percentage of volume towards the decadal commitment from this analysis area. Approximately 60% of the regeneration decadal commitment in the next decade will come from the analysis area. This is supported by the high amount of acreage currently in the 60 year age class moving into the 70 year age class next decade, thus potentially available for regeneration harvest. *Note: 11.7 MMBF sold or planned for the analysis area (1995-2004) / 17.289 MMBF decadal commitment = 68% of decadal commitment. **Analysis was done using TRIM PLUS modeling based on 70 year and older conifer and 50 year and older hardwood.	C Because of past practices, the age class distribution is not even across the landscapes. Consider deferring further regeneration harvest in the analysis area until next decade when the 60 year age class moves into the 70 year age class, unless resource impacts in other watersheds are at higher risk as compared to this low impact analysis area.

Issue	Findings	Recommendations
	2) Sold or planned commercial thinning within the analysis area fulfills approximately *65% of the resource area decadal commitment. **The decadal annual sale quantity from this analysis area is estimated to be 47 percent. Approximately 20% of commercial thinning volume in the next decade will come from the analysis area. The opportunities for the next decade may be greater than TRIM Plus projections because of the acreages moving into the 30 and 50 year age classes (especially if considering double entry thinnings). *Note: 5.189 MMBF sold or planned for the watershed (1995-2004) ÷ 7.963 MMBF decadal commercial thinning commitment = 65% of decadal commitment. **Analysis was done using TRIM PLUS modeling based on 40 to 60 year age classes.	C Limit commercial thinning in those stands targeted for single entry until next decade. C Accelerate stand exams in stands showing potential for producing resource benefits. If we find that there are more stands than projected, adjust the RMP annual sale quantity.
	3) Plantation maintenance and release needs have been reduced considerably by large service contracts and by a reduced regeneration harvest. RMP estimates based on the analysis acres tend to be higher than data base (micro-storms (M*S)) records from surveys indicate. Also, brush competition is not as severe a problem in the analysis area as in other resource area watersheds. The stands in the analysis area therefore, require fewer acres of maintenance and release treatments. Few acres in the analysis area have been given seedling protection treatment over the last ten years.	C Proceed with intensive silvicultural practices to maximize quality and production.
	4) Late-Successional Reserve acres account for approximately 8% of the BLM land in the analysis area. The Oregon State University research project is proposed to treat approximately 102 acres this decade.	C See Research Section.

Issue	Findings	Recommendations
2) Special Forest Products	1) Special forest product collections in the analysis area and in the Marys Peak Resource Area are minor. Products are available in this analysis area but are generally harvested in the South Fork Alsea watershed. Reasons for this may include: BLM lands are blocked up in the South Fork area making it easier to identify BLM lands, and the vegetation may be of better quality along the lower elevations of the South Fork Alsea River.	C Follow the district RMP, special forest products handbook and the Marys Peak Resource Area categorical exclusion for guidance on the sale of special forest products. C Provide educational materials on the collection of SFP and make available to the public.
3) Transportation	1) Drainage structures on many of the BLM controlled roads are deteriorating and/or are inadequately sized for 100-year flood events.	C See Appendix 9 for a prioritized list of potential culvert replacements on BLM controlled roads. That list contains approximately twelve existing culverts that are deteriorating. An additional eight culverts were identified as inadequate in the road inventory process and will be replaced by either the BLM maintenance crew or in association with planned timber sales. Another twenty-one culverts were found to need some form of maintenance to return them to full capability.
	2) Approximately 1.65 miles of unsurfaced roads provide legitimate year-round administrative traffic that results in soil displacement (ie: wash, tires ruts, etc.) when used during wet periods. Roadbed rutting on natural surfaced roads used by OHV is occurring attention requiring attention.	C See Appendix 9 for a prioritized list of recommended BLM road segments where surface rock should be placed and surface drainage devices (i.e. waterbars, draindips, etc.) installed. Appendix 10 lists roads where measures to restrict access should be taken. Whenever possible, these improvements will be accomplished in conjunction with timber sale activities, otherwise, when funding sources become available (Map 20).

Issue	Findings	Recommendations
	3) Due to lack of maintenance, some ditches, catch basins, and culvert inlets have obstacles obstructing seasonal flows. These include bank ravel, slash, or other forms of debris that can effectively dam the water course diverting it onto road surfaces or over embankments where erosion can occur.	C Identify areas where the likelihood for drainage problems exists and establish a means for rating risk potential (both probability and potential). The rating would be included in the Transportation Management Objectives (TMO) data base and would indicate which sites require more frequent field inspections and drainage repair.
	4) Four log drainage structures were located on BLM lands during the road inventory process. All of these structures are well beyond their design life and have either collapsed or are in the process of doing so. The identified structures are all located on roads that are long abandoned or have not received commercial use in decades.	C Road 13-6-15 has two failed log structures on Duffy Creek tributary streams, and Road 13-6-27 has two log structures in the process of failing on a Starr Creek tributary stream. All four are earmarked for removal, the creeks restored to their natural streambeds, and the roadbeds obliterated and grass seeded whenever a funding opportunity becomes available (see Appendix 10, Prioritized List of Roads for Potential Closures).
	5) In general, avoid new road construction in riparian reserves to meet Aquatic Conservation Strategy objectives. The current planning process for new road construction requires the involvement of affected resource specialists, including the hydrologist, soils scientist, botanist, wildlife biologist and/or aquatic biologist, and road engineer. At the present time, the Best Management Practices are being used to help determine the road location, general road design features, design of cross drains and stream crossings, as well as the actual road construction.	C Continue this interdisciplinary process of evaluating each new road proposal, and when needed, utilize specialists from outside the agency to verify findings. C When interdisciplinary teams are considering proposals for constructing road crossings on stream channels (as defined in the ROD), the Benton Foothills analysis area team has recommended a methodology described in Chapter 5&6.

Issue	Findings	Recommendations
4) Recreation	1) Use of public lands by off-highway vehicles is extensive and virtually unmanaged.	C Designate a trail system which will be managed for off-highway vehicle use and protects other resource values. a. Complete a survey/inventory of all OHV trails on the BLM in Benton County and determine trail condition, with emphasis on trails within riparian reserves and at stream crossings. b. Work with the Flat Mountain Trail Riders group, Starker Forest Products, Inc., and other individuals/groups to develop and implement a trail and maintenance plan. This plan would address: Improve stream crossings on the designated system. Repair damaged segments of the designated system. Close trail segments which are not part of the designated system. Monitor use to ensure resource conditions on the trail system meet Aquatic Conservation Strategy objectives. c. Marys Peak Resource Area should identify an individual to work directly with the groups to develop and implement the recommended plan of action.
	2) The transportation system is used for a variety of recreation activities. Other than maintenance of roads, improvements to facilitate recreation use are nonexistent.	C Install and maintain road signs on BLM-controlled roads. C Develop Memorandums Of Understanding with private land owners to allow public access on key roads across private lands.

Issue	Findings	Recommendations
	3) Competitive mountain bike events have been held in the north part of the analysis area. Interest has been shown in similar events in the Bellfountain area. These events need to be carefully planned by the sponsors and BLM to avoid conflicts with motorized vehicles and to minimize resource impacts.	C Follow BLM procedures for granting permits for these events. C Work with the sponsors to locate sites and trails for the events. Health and safety of riders and spectators and protection of public resources should be overriding concerns. C Monitor sites and trails before, during, and after the event.
5) Research	1) Density management research is being planned for the Green Peak LSR block. This will be a long-term project.	C Promote additional research in this block only if it is compatible with the current project. C Screen all proposed management projects against the research plan and allow projects which are compatible with research. C Assist the researchers with design, field layout, data collection, and monitoring as appropriate.
6) Land Tenure	1) The analysis area is in Land Tenure Zone 2, as designated in the RMP/ROD. Lands within this zone may be blocked up in exchange for other lands in Zones 1 or 2, transferred to other public agencies, or given some form of cooperative management.	C Scattered tracts in T.13S., R.6W., Sections 13, 15, 23, 25, 27 and 35. a. Conduct an inventory to determine whether these tracts should or should not be kept as BLM-administered land; consider significant ecological values. b. Proceed with exchange or transfer of tracts which should not be kept as BLM-administered land.

Issue	Findings	Recommendations
		C Large checkerboard blocks in west part of analysis area a. Identify areas which could benefit from blocking up public lands. Acquisition of T.14S., R.6W., Sec.6 would block up LSR lands. Acquisition of T.13S. R.6W, Sec.30 would enhance riparian reserve connectivity on Oliver Creek. b. Identify areas where blocks could be given up for exchange; inventory for significant ecological values.
7) Rural Interface Areas	1) Several rural interface areas extend up drainages to a short distance from public land. A ROD/RMP objective is to consider the interests of adjacent or nearby rural land owners when planning and implementing management activities.	C Contact neighbors during project planning and determine their interests and concerns regarding the proposed activities. C Develop design features and mitigation measures that will minimize the possibility of conflicts with our neighbors (see ROD/RMP, p.39, for suggested features and measures.) C Monitor the effectiveness of design features and mitigation measures during and after project implementation.
8) Unauthorized/Unmanaged Uses	Industrial land owners and BLM are concerned with increases in dumping, vandalism, and shooting.	C Continue to identify areas that are used for dumps, shooting, and vandalism. C Clean up dump areas, block spurs used for shooting, and keep law enforcement informed.
9) Visual Resource Management	The analysis area is primarily VRM 4 lands, with a small acreage (92 acres) of VRM 2 lands.	C Follow RMP guidelines.

CHAPTER 1 - CHARACTERIZATION

The Analysis Area

The Benton Foothills watershed analysis area (hereinafter referred to as the analysis area), located in the Upper Willamette River Basin, encompasses about 80,647 acres of the Coast Range foothills and western edge of the Willamette Valley, south Benton County (Figure 1). To the north of the analysis area is Highway 34, and to the east is Highway 99W. About 8 percent of the analysis area (6,149 acres) is under BLM management. William L. Finley National Wildlife Refuge totals 5,325 acres (7 percent), and the remaining land is in private ownership. The communities of Bellfountain, Dawson, Glenbrook, and Alpine are located within the analysis area boundaries.

The uplands are primarily forested areas in federal ownership or private industrial forest ownership. The lowlands are mainly agricultural lands and orchards, Christmas tree plantations, and pasture, interspersed with remnant oak/savannah habitat.

The analysis area is part of the fifth-field Marys River Watershed. Small streams in the analysis area flow into Muddy Creek and Greasy Creek, and then to Marys River. Lands in the headwaters of Greasy Creek are included in the analysis area as they are the only other remaining BLM land in the Marys River Watershed not covered by watershed analysis (approximately 720 acres total), and they are similar in character to this area.

The Siuslaw National Forest has scheduled first iteration analysis of the Marys River Watershed for Fiscal Year 1999. The Marys Peak Resource Area priority for analysis is Fiscal Year 1997. A large percentage of the resource area Matrix allocation (primary timber management area) is in the south part of the Marys River Watershed. Timely watershed analysis is needed to provide an ecosystem framework for future management proposals. The Marys Peak Resource Area and Siuslaw National Forest managers discussed and reached agreement to accelerate analysis of a portion of the Marys River Watershed (i.e., the Benton Foothills Watershed Analysis Area). This allows BLM immediate priority for analysis. The results of the partial watershed analysis will be incorporated in the full analysis in Fiscal Year 1999.

The Benton Foothills analysis focuses on the uplands with limited projection on the lowlands, agricultural lands, and the William L. Finley Wildlife Refuge.

Land Uses

BLM

The Salem District Resource Management Plan (RMP) allocates BLM-administered land to specific purposes and establishes management actions/direction for each allocation. The RMP incorporates all of the relevant decisions made in the Northwest Forest Plan and its Attachment A. The land allocations and management actions and direction in the RMP provide the basic management guidance for this watershed analysis area.

C Land Allocations and Acreage Within the Watershed Analysis Area:

Late-Successional Reserve (LSR) (includes 127 acres, unmapped, for Northern Spotted Owl Core Area)	503 acres
Matrix (General Forest Management Area)	5,646 acres

These allocations contain no overlaps.

C Other land allocations which overlap those listed above:

Riparian Reserves	2,654 acres

Riparian Reserve overlaps could not be eliminated due to limitations in the database.

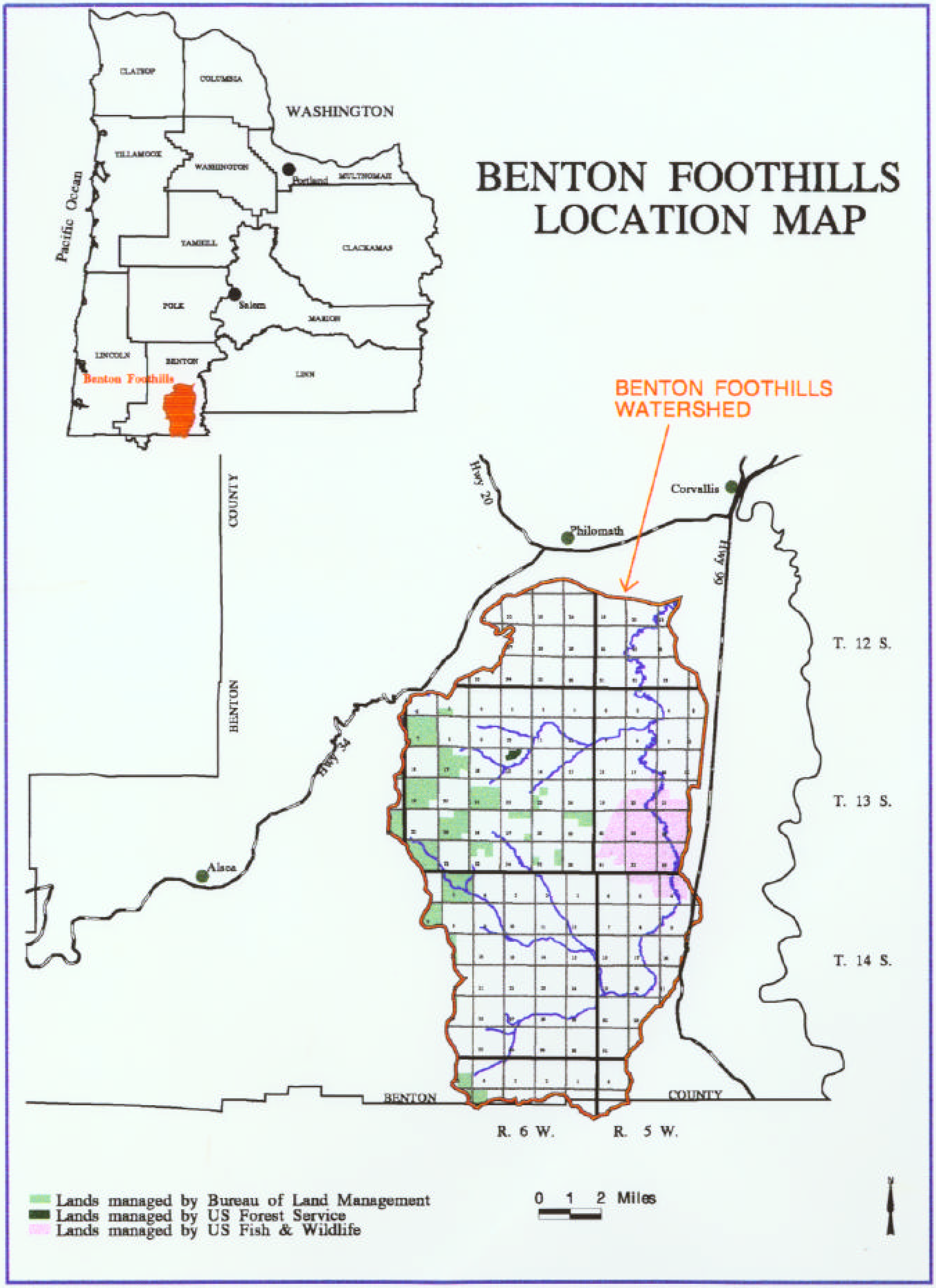
See Appendix 1 for a description of all other RMP allocations and resource programs relevant to this watershed analysis area.

C RMP Issues, Management Actions/Direction, and Expected Future Conditions and Outputs

C RMP Issue 1. Timber Production Practices

Land allocation in the analysis area which addresses the issue - Matrix (General Forest Management Area).

See Map 1 for location of the Matrix. The Matrix allocation does not include reserves. Management of other allocations, such as Late-Successional Reserves, will produce some timber, but they will not be managed with timber production as an objective.



BENTON FOOTHILLS LOCATION MAP
WASHINGTON
Pacific Ocean
CLATSOP
COLUMBIA
TILLAMOOK
WASHINGTON
MULTNOMAH
Portland
YAMHILL
CLACKAMAS
POLK
Salem
MARION
LINCOLN
BENTON
LINN
Benton Foothills
BENTON FOOTHILLS WATERSHED
Hwy 20
Corvallis
Philomath
Hwy 99
Hwy 34
Alsea
BENTON COUNTY
T. 12 S.
T. 13 S.
T. 14 S.
R. 6 W.
R. 5 W.
Lands managed by Bureau of Land Management
Lands managed by US Forest Service
Lands managed by US Fish & Wildlife
0 1 2 Miles

Management actions/direction which address the issue:

The Matrix will be managed for timber production but a legacy of the previous forest will be left in harvest units, i.e., green trees, snags, and down wood.

See pages 20 - 22 and 46 - 48 of the RMP Record of Decision (ROD) for details on how the Matrix will be managed.

Expected future conditions and outputs in the Matrix.

Production of a stable supply of timber and other forest commodities.

Maintenance of important ecological functions such as dispersal of organisms, carryover of some species from one stand to the next, and maintenance of ecologically valuable structural components such as down logs, snags, and large trees.

Assurance that forests in the Matrix provide for connectivity between Late-Successional Reserves.

Provision of habitat for a variety of organisms associated with early and late-successional forests.

RMP Issues 2 and 3. Old Growth Forest/Habitat Diversity/Wildlife Habitat

Land allocations in the analysis area which address the issue - Matrix, Late-Successional Reserves and Riparian Reserves

The land allocations in the RMP are designed, in the aggregate, to benefit wildlife species that use the various seral stages and other habitat areas of the forest.

Management actions/direction which address the issue:

Use the watershed analysis process to address wildlife habitat issues for individual watersheds.

Manage Late-Successional Reserves to retain or reestablish late-successional forest characteristics. Density management in stands less than 80 years of age and other appropriate management activities may be undertaken to achieve Late-Successional Reserve objectives.

In the Matrix:

retain snags within timber harvest units at levels sufficient to support species of cavity nesting birds at 40 percent of potential population levels;

retain late-successional forest patches in landscape areas where little late-successional forest exists;

retain six to eight large, green conifer trees per acre after regeneration harvest; in addition, retain large, green trees for snag recruitment where there is an identified near-term deficit;

leave 240 linear feet of logs per acre greater than or equal to 20 inches in diameter.

See pages 15 - 19 of the RMP ROD for additional details on how allocated areas and other wildlife habitat will be managed.

Expected future conditions and outputs

Development and maintenance of a functional, interacting, late-successional and old-growth forest ecosystem.

Protection and enhancement of habitat for late-successional and old-growth forest-related species including the northern spotted owl and marbled murrelet.

Enhancement and maintenance of biological diversity and ecosystem health to contribute to healthy wildlife.

C RMP Issues 7 and 8. Stream/Riparian/Water Quality/Fish Habitat

Primary land allocation in the watershed analysis area which responds to the issue - Riparian Reserves.

One other important means of protecting water quality is the timber production capability classification (TPCC) inventory, which identifies specific fragile sites and other areas where management will be restricted to protect soil resources.

Management actions/direction which address the issues:

In Riparian Reserves, prohibit or regulate activities that retard or prevent attainment of Aquatic Conservation Strategy objectives. See pages 9 - 15 of the RMP ROD for Aquatic Conservation Strategy objectives and detailed management actions/direction for Riparian Reserves.

Complete Watershed analysis and appropriate National Environmental Policy Act compliance prior to changing Riparian Reserves in any watershed.

Plan and implement watershed restoration projects to aid recovery of fish habitat, riparian habitat, and water quality.

Use best management practices and fragile site management guidelines to protect soil and water resources (see appendix G of the RMP ROD for details).

See pages 22 - 24 of the RMP ROD for additional details.

Expected future conditions

Restoration and maintenance of the ecological health of watersheds.

Compliance with state water quality requirements to restore and maintain water quality to protect recognized beneficial uses.

Improvement and/or maintenance of soil productivity.

U.S. Fish and Wildlife (USFW) and U.S. Forest Service (USFS)

The USFW manages the William L. Finley Wildlife Refuge. The primary goal of the refuge is to create optimal habitat for wintering dusky Canada geese. This includes providing an abundance of short, tender, high-protein plants for browse, and open water for loafing and resting. Another management goal is to preserve native species and enhance biodiversity (Map 2).

The USFS manages approximately 40 acres as a seedling nursery and seed orchard.

Geology

C The highest point in the analysis area is the top of Green Peak, with an elevation of approximately 2,700 feet. The lowest elevation is about 250 feet on the Willamette Valley floor (Map 3).

C According to the average rainfall map (1961-1990), rainfall varies from about 40 inches on the Willamette Valley floor to about 70 inches at higher elevations in the analysis area (State Climatologist, Oregon Climate Service).

C Eighty percent of the precipitation occurs during the months from October through March.

C Historically, August is the warmest month of the year with an average air temperature in the mid-60 EF. The average temperature in January is in the low 40 EF.

- The analysis area includes areas in the “Xeric zone” and “Moist zone” (Timber Production Capability Classification Technical Guide 1987).

- The Xeric zone is found primarily along the fringes of the Willamette Valley and the valley itself at elevations generally below 1,000 feet. Landforms include flat to moderately steep sloping hillslopes and rolling colluvial slopes. Annual precipitation ranges from 40 to 60 inches. Root-zone soil temperature remains above freezing during the winter months. Evapotranspiration exceeds precipitation beginning in late April. The soil moisture deficit is about 10 to 12 inches (moisture use during the growing season). Turnover rate of organic matter is rapid. Soils are dark reddish-brown and gravelly on the hillslopes and clayey on the colluvial slopes. Biomass production is moderate to low.

- The Moist zone is found in the intermediate elevations (1,000 to 2,000 feet) of the Benton-Foothills analysis area. Landforms are steep hillslopes and rolling colluvial slopes. Annual precipitation ranges from 60 to 70 inches. Root-zone soil temperatures remain cold into April. Evapotranspiration exceeds precipitation beginning late May or early June. Soil moisture deficit is about 6 to 10 inches. The turnover rate of organic matter is moderate. Soils are dark reddish-brown on the older colluvial surfaces, dark brown and loamy on the younger surfaces, and dark reddish-brown and gravelly on the steep hillslopes. Biomass production is moderate to high.

Soil Compaction and Displacement

- Most of the lands in the analysis area (especially private) were logged between the 1930s - 60s. Cable logging with steam donkeys during the 1930s - 40s did not leave much residual site damage. Tractor logging became prevalent in the mid 1940s - 60s and created higher levels of soil disturbance, displacement, and compaction. Most of the impacts to sites remain to this day.

Erosional Processes

- Compared with adjacent watersheds to the west, the topography of the analysis area consists of more moderately sloped terrain. There are small inclusions of steep to very steep sloping lands primarily along the western edge of the analysis area.

- Dominant erosional processes are deep seated slump earth flows and surface soil erosion.

- Clearcut and road-related landslides have increased the rate of sediment introduction to stream channels. However, because of the more moderate terrain, landslides are less common than on steeper sloping watersheds.

- Highest risk for landslides lies along the western margin of the analysis area.

- Soils generally are old, mature, deep, and fine-textured.

Vegetation

- The analysis area was subject to widespread, frequent burning prior to the 1850s.

- Early maps and writings describe the areas around present day Bellfountain, Dawson, Glenbrook and similar locales as being "open woodlands" comprised of grasslands interspersed with occasional oak and fir trees. Today much of this area is "woodland" forested with Douglas-fir.

- Very few remnants of original timber stands exist in the Benton Foothills so reconstructing a fire history is difficult. The presence of oak indicates fuel loadings were at low levels (compared to interior coastal forests).

- The Valley zone is located on and adjacent to the Willamette Valley floor on warm, dry sites at elevations up to 1,000 feet on south slopes and under 300 feet on north slopes. Major tree species include Douglas-fir, grand fir, big-leaf maple, white oak, and madrone. Shrubs include hazel, ocean spray, snowberry, Oregon grape, and poison oak. Historically, most of these sites have experienced frequent fires.

- The Foothills zone occurs on moist sites of the east Coast Range slopes, ranging from about 1,000 to 2,000 feet. Major conifer tree species include Douglas-fir, western hemlock, and western red cedar. Predominant shrubs are red huckleberry, salal, vine maple, and blackberry. Red alder and big-leaf maple are present in varying amounts. Red alder grows on exposed mineral soil. The herb layer, when present, is dominated by swordfern and oxalis. Plant communities vary depending on the impact and presence of marine airflows across the Coast Range. Drier sites have more ocean spray, snowberry, madrone, and herbaceous species than wetter sites.

- The Uplands Zone is found between 2,000 and 3,000 feet. Major conifer species include Douglas-fir, western hemlock, and western red cedar. Red alder and big-leaf maple are present in varying amounts. Red alder grows on exposed mineral soil. Predominant shrubs are red huckleberry, salal, vine maple, and blackberry. Rhododendron and beargrass may occur on ridgetops. The herb layer, when present, is dominated by swordfern and oxalis. Plant communities vary depending on the impact and presence of marine airflows across the Coast Range. Drier sites have more ocean spray, chinquapin, and herbaceous species than wetter sites.

C Survey and mange species known to occur in the watershed include fifteen fungi and eleven lichens.

C Noxious weeds known to occur include: Scotch Broom (*Cytisus scoparius*), Canada Thistle (*Cirsium arvense*), Bull Thistle (*C. vulgare*), St. Johnswort (*Hypericum perforatum*), and tansy ragwort (*Senecio jacobea*).

Riparian Reserves

C Riparian Reserves comprise 43% of the BLM land in the analysis area.

C The primary human disturbance to the Riparian Reserves has been logging and road building. As a result, less than 10% of the Riparian Reserves are unmanaged, and about 60% are composed of stands less than 50 years old. Approximately 432 acres of the younger stands are typed as hardwoods. Most hardwood areas are within 100 feet of the stream.

C There is a shortage of decay class one and two down large woody debris and snags in the Riparian Reserves.

Hydrology

C Low stream densities associated with relatively gentle topography.

C Primarily precipitation driven runoff rather than snow or rain-on-snow.

C Deep soils and gentle topography produce high water tables, wetlands, sag ponds and large water storage potential in riparian flood plains.

C Long term, cumulative effects due to forest and agricultural land management practices have likely altered runoff, stream flow intensity and duration, and water storage processes in the analysis area.

C Agricultural and, increasingly, urban water uses are critical factors in the maintenance of adequate flows and water quality in the summer.

Stream Channels

C Low gradients and alluvial soils result in meandering stream systems that are particularly sensitive to alterations of inputs (sediment, water, organic material).

C Fine particle sizes predominate in the banks and beds of the stream system and therefore, riparian vegetation is especially critical to the maintenance of channel form and function.

C Stream channels and associated flood plains have been altered (flood plains ditched and drained; streams straightened, channelized; riparian vegetation limited to remnant bands immediately adjacent to streams) to accommodate agricultural and urban needs.

Water Quality

C Marys River is listed in the Department of Environmental Quality's 1996 303(d) report as water quality limited for flow modification, temperature (summer), and fecal coliform from the mouth to Greasy Creek. Muddy Creek and its tributaries are not listed.

C Anecdotal evidence indicates that cold water aquatic species are leaving the Muddy Creek system in summer for cooler water in the Willamette River mainstem. This suggests that stream temperatures in Muddy Creek and its tributaries may be high in the summer.

C Fine sediment loads in the Muddy Creek stream system are high relative to coastal and Cascade streams.

C The primary sources of water quality degradation are likely agricultural and urban while forest management is critical in the maintenance of water quality in headwater source areas.

C Beneficial uses include irrigation, livestock watering, domestic use (ground water and surface), fisheries and aquatic life, and recreation. The Corvallis municipal watershed is in Rock Creek, tributary to Greasy Creek.

Fish Species and Habitats

C Oregon chub, a federally listed species, inhabits Gray Creek.

C Other fish species present in the analysis area are: bullhead cat (*Ictalurus* spp.), bluegill (*Lepomis macrochirus*), Oregon chub (*Oregonichthys crameri*), speckled dace (*Rhinichthys osculus*), redside shiner (*Richardsonius balteatus*), three-spine stickleback (*Gasterosteus aculeatus*), Northern squawfish (*Ptychocheiles oregonensis*) and resident trout.

C Data on habit conditions are limited. Substrates and barriers are properly functioning in subwatersheds with available data. Large woody debris, pool area and pool quantity are not properly functioning.

Wildlife Species and Habitat

Habitat

C Wildlife habitats found on BLM lands in the analysis area include 1,758 acres of early seral, 3,226 acres of mid-seral, 444 acres of late seral, and 20 acres of old-growth.

C 503 acres of habitat is within LSR, reserved for northern spotted owls and marbled murrelets.

C Special habitats include wetlands, caves, cliffs, meadows, and talus slopes are generally lacking on BLM lands within the analysis area (see Vegetation section, Ch.3&4).

C Topography and human influence have created high contrast landscape patterns. The most connected portions of the landscape are the forested uplands and agricultural lowlands (Willamette Valley). The foothills are a transitional zone, previously oak-savannah and grasslands, now forested with conifers. The forested uplands are large, contiguous stands of young trees. North - south connectivity for late seral species movement to interior forests exists.

C The forested uplands are fairly homogenous in terms of habitat diversity. Remnant old-growth trees and downed wood are found throughout the forested areas.

Wildlife Species

C Approximately 120 birds, 63 mammals, 14 amphibians, and 10 reptiles inhabit the analysis area.

C Threatened and Endangered Species that may be found include Northern spotted owls and marbled murrelets.

C The analysis area has one Northern spotted owl pair with a designated 100-acre reserved core area.

C Marbled murrelet surveys conducted over the past six years have yet to detect murrelets using the habitat within this analysis area.

- Thirteen Survey and Manage Species have been found in the analysis area.

Human Uses

Commodity Forest Products

Commercial Timber

- RMP First Decadal Targets for Matrix Lands in the Analysis Area
    - Regeneration Harvest 100 acres 5.186 MMBF
    - Commercial Thinning 230 acres 3.742 MMBF
        - TRIM PLUS projected the analysis area would contribute approximately 30 percent of the decadal regeneration commitment and 47 percent of the decadal commercial thinning commitment for the Marys Peak Resource Area.

- Potential Harvest Acres

Harvest Regime	Ages	1997	2005
Commercial Thinning	20-40	1,396	unknown
(outside riparian reserves)	40-70	914	
Density Management	20-40	868	unknown
(inside riparian reserves)	40-70	768	
Regeneration	70+	408	1,092
Total		4,354	

- RMP Second Decade Targets for Matrix Lands in the Analysis Area
    - Regeneration Harvest 198 acres 10.373 MMBF
    - Commercial Thinning 140 acres 1.433 MMBF
        - TRIM PLUS projected the analysis area would contribute approximately 60 percent of the decadal regeneration commitment and 18 percent of the

decadal commercial thinning commitment for the Marys Peak Resource Area.

- Accomplished and Planned Sales/Offerings

  - Sold/Offered 1995- 97 (including Tobe Replacement modification)

	#	Acres	MMBF
C Regeneration	2	117	7.101
C Commercial Thinning	1	200	4.000
Total	3	317	11.101

  - Planned 1997 - 2004 (starting with Reese Cr.)

C Regeneration	3	76	4.621
C Commercial Thin	1	74	1.189
Total	4	150	5.810

Output from Other Management

- 102 acres planned for density management research in 1998; approximately 0.772 MMBF proposed for harvest.

Silvicultural Treatments

- RMP First Decade Targets for Matrix Lands in the Analysis Area

Treatment	Acres
Tree Planting-regular stock	170
Tree Planting-genetic stock	60
Site Preparation-fire	130
Other Site Preparation	100
Stand Maintenance/Release	320
Stand Protection	100
Pruning	350
Hardwood Conversion	0
Precommercial Thinning	590
Fertilization	560

C Accomplished Treatments (1995-1997)

Treatment	Acres
Tree planting-regular stock	32
Site Preparation-fire	45
Stand Maintenance	113

- C Timber harvest and associated treatment acres were low during initial implementation of the RMP

Special Forest Products

C Sixty-seven permits were issued in the analysis area during Jan.-Dec.1996. Forty-five of these permits were chanterelle mushroom permits; the permits included contract areas in portions of the adjacent South Fork Alsea Watershed.

C Special Forest Products are not a major activity in this analysis area nor in the Marys Peak Resource Area in general.

Transportation

C Estimated road miles in the forested uplands are as follows:

Rocked Roads	Miles
1) BLM control on BLM lands	24
2) BLM control on private lands	2
3) Private control on private lands	124
4) Private control on BLM lands	1
Native Surface Roads	
1) BLM control on BLM lands	8
2) Private control on private lands	66

C The existing road density on BLM lands is approximately 3.5 miles of road per square mile of land.

C A number of primitive spurs are used by motorcycles. Some of these "trails" are located on steep slopes with evidence of runoff and scouring in the tire tracks. There are approximately 17 miles of native-surfaced roads along with 9 miles of trails that are known motorcycle routes.

- Except for the railroad grades which were constructed in the early 1900s, the majority of the upland roads in this analysis area were built between 1940 and 1970. On BLM lands, an estimated 18 percent of the culverts have, over time, deteriorated and will soon need replacing, and 14 percent do not meet the 100-year flood criteria. BLM roads appear stable with little recent slide/slump action.

- Starker Forests, Inc., Weyerhauser Company, and the Lowthers' maintain fairly extensive gate systems with differing closure policies. Ultimately, however, all roads crossing private lands can legally be closed, and with increased vandalism, dumping, and theft, additional closures are likely (which in many cases would affect public access onto BLM lands).

- Nearly all roads that pass through more than one ownership are encumbered with Reciprocal Right-of-way Agreements. The landowners we have cooperative agreements with include Starker Forests, Swanson Superior Forest Products, Inc., Hull-Oakes Lumber Company, Weyerhauser Company, Agency Creek Management Company, and Rosboro Lumber Company.

- We also have non-exclusive easements across private lands, including Botkin (Botkin Road), Lowther (Glenbrook Road), and Bullis and Melby (Beaver Creek Road).

Recreation

- Access

  State Highway 34 provides primary access to the northern edge of the analysis area. Most travelers simply pass by on their way to and from the Oregon Coast and the Willamette Valley. The highway intersects with BLM and county roads which provide access to public lands for local and regional recreation users.

State Highway 99W and the paralleling Bellfountain County Road provide the north/south access along the eastern (lowlands) edge of the analysis area. A number of county roads proceed west into the uplands off of these two routes. Highway 99W is a major arterial linking Corvallis with Eugene.

South Fork Alsea Road provides access to a small portion of the analysis area at the southern end. Designated a National Back Country Byway, it accommodates a variety of users.

Other forest roads and trails: BLM and private controlled secondary roads connect to collector or public road systems. These roads receive lower traffic volumes and are generally single lane, gravel roads, receiving infrequent maintenance. Because the majority of these roads have a variety of controlling parties, access can be terminated at any time. Most recreation travelers are from the foothill communities, utilizing the roads for specific purposes (e.g., hunting, motorcycle use). A local motorcycle club mapped and signed an extensive system of dirt bike trails within the analysis area. The club administers a permit system and requires permittees to assist with trail maintenance work. Other non-associated motorcycle riders also utilize the trails. Some mountain bike (pedal) riding also occurs.

- Attractions

  Streams - limited fishing (source: Gary Blanchard, Starker Forest Products, Inc.), although the locals know where to catch cutthroat (source: George Ice, NCASI).

  Wildlife - viewing a variety of wildlife species and their habitats.

  Hunting - Fairly intensive hunting of deer; less successful elk hunting; and some hunting of upland game birds (source: Dr. Doug Cottam, ODFW).

  Special Forest Products - collecting for personal use (e.g., mushrooms)

  Open Space - a place to drive on and off surfaced roads to enjoy the forest environment

  Developments (other than roads and trails) - none managed by BLM

- Management Concerns

  Possibly some user conflicts (e.g., motorcycles vs. mountain bikes).

  Off-highway vehicle (OHV) "improvements" on public lands are basically unmanaged, unapproved, and without standards (e.g., creation of trails on sensitive terrain, signs installed without permission).

  Increasing interest in mountain bike (pedal) racing and riding.

Tribal Interests

- The Grand Ronde and Siletz Tribes have been contacted; no information has been received at this time.

Research

- The Green Peak LSR is proposed for density management research.

- Beaver Creek Progeny Test Site, located in T.13S., R.6W., Sec.19 was established in

1983 as part of the Forest Genetics Program. The trees are scheduled for 15 year measurement in the fall of 1997.

Land Tenure

- C In the higher elevations, BLM lands are interspersed (checkerboarded) with private in large ownership blocks (+320 acres); smaller blocks (40-240 acres) are located in the lower elevations.

- C The analysis area is designated Land Tenure Zone 2 in the RMP. Some lands could possibly be exchanged to create larger BLM ownership blocks either in this zone or in Zone 1.

    - C Smaller BLM parcels may be managed more effectively by adjacent private landowners than by the BLM.

    - C Management of BLM lands may be made more efficient by blocking the lands into larger parcels.

Rural Interface Areas (residential areas near BLM lands)

- C Known Areas:

    Botkin Road - a rural community of 10 to 20 residences, utilizes the first mile of this BLM controlled road as their access route.

    Reese Creek Road - a sizeable population lives in the Reese Creek drainage, backed up to the timbered hills.

    Beaver Creek - a rural population lives in the Beaver Creek drainage, backed up to the timbered hills.

    Alpine area - extensive zoning exists for rural-residential development. There are an unknown number of residences spread over a broad land base.

- C Management Concerns:

    Botkin Road - home owners often express concerns over the infrequent BLM maintenance resulting in dust and potholes, as well as frustrations over speeding vehicles.

Other areas - Some residents of the analysis area are concerned that any area timber harvesting and/or road construction will increase flooding and stream siltation.

Unauthorized / Unmanaged Uses

Industrial land owners and BLM are concerned with increases in dumping, vandalism, and shooting.

Visual Resource Management (VRM)

- VRM class designations
    - VRM class II 92 acres
    - VRM class IV 6,057 acres

Chapter II - Issues and Key Questions

Introduction

This chapter identifies the specific issues that are relevant to the Benton Foothills analysis area. These issues were used to develop key questions which focus the analysis on particular types and locations of cause-and-effect relationships, and discern conditions as they relate to values, uses and key ecosystem components and processes of the watershed.

A variety of sources provided insight into the values and uses which lead to the issues for this watershed analysis. They include recent analysis documents such as the *Northwest Forest Plan* on a regional level, the *Water Quality Sampling of Muddy Creek Watershed, Benton County, Oregon* (Cascade Pacific Resource Conservation & Development. September 10, 1996), and the *Modeling Risks to Biodiversity in Past, Present and Future Landscapes* (Freemark K., C. Hummon, D. White and D.Hulse. 1996. Technical Report Series Number 268). Interactions with landowners, other interested individuals and groups, and discussions with county, state and federal resource specialists also helped to identify issues and key questions.

Soil Compaction and Displacement

Issues

Road construction and past timber harvest activities resulted in loss of soil productivity, compaction and displacement in parts of the analysis area. These have adversely impacted water quality and aquatic species habitat.

Key Questions

C What were the historical patterns of soil productivity and related compaction and displacement effects?

C What are the current conditions and trends of soil productivity and associated compaction and displacement effects?

C What are the opportunities to manage soil resources in order to maintain or enhance desired future conditions?

Erosional Processes

Issues

Road construction and past timber harvest activities have increased landslide and general sedimentation rates beyond natural levels, and have adversely impacted water quality, aquatic species habitat, and soil productivity.

Key Questions

- What were the historical erosion processes (e.g., surface erosion processes, mass wasting)?
- What are the current conditions and trends of the dominant erosion processes?
- What are the natural and human causes of changes between historical and current erosion processes?
- What are the influences and relationships between erosion processes and other ecosystem processes (e.g., vegetation, woody debris recruitment)?
- What are the opportunities to manage soil resources in order to maintain or enhance desired future conditions?

Vegetation

Issues

Ecological succession coupled with human-caused and natural disturbances has created a mosaic of vegetation types which are quite different from vegetation patterns of the past. Although vegetation patterns are never static, the rate and intensity with which these patterns change can be greatly affected by management activities. Several non-native plant species have been introduced to this ecosystem, and some native plant communities are now declining.

Key Questions

- What was the historical array and landscape pattern of plant communities and seral stages? What processes caused these patterns?
- What are the current conditions and trends of the prevalent plant communities (including

riparian), seral stages, and special plant species in the watershed? What activities and processes (e.g. recreation, noxious weeds, logging) threaten the biological integrity of sensitive botanical areas (Outstanding Natural Areas)?

- What are the natural and human causes of change between historical and current vegetative conditions? What are the influences and relationships between vegetation and seral patterns and other ecosystem processes (e.g., hydrologic maturity, channel stability)?

- What are the opportunities to manage vegetation in order to maintain or enhance desired future conditions?

Riparian Reserves

Issues

Riparian area modifications such as road construction, physical alteration of stream channels, and removal of riparian vegetation have changed plant and animal species composition and decreased structural diversity. This has resulted in altered habitat for riparian associated species. Lower gradient streams tend to be entrenched, and therefore disconnected from their flood plain, altering stream function and riparian area microclimates. Many riparian areas are deficient in large conifers which are future sources of large woody debris.

Key Questions

- What were the historical and landscape patterns of riparian ecosystems?

- What are the current conditions and trends of processes which affect riparian ecosystems?

- What are the criteria and/or conditions for determining various management actions or restoration projects within riparian reserves?

Hydrology

Issues

Modifications of hillslopes and riparian areas from road construction and harvest may have altered the timing, duration and quantity of stream flows in the analysis area.

Key Questions

- C What were the historical hydrological characteristics (e.g., total discharge, peak flows, minimum flows) and features (e.g., cold water seeps, ground water recharge areas)?

- C What are the current conditions and trends of the dominant hydrologic characteristics and features prevalent in the analysis area?

- C What are the natural and human causes of change between historical and current hydrologic conditions?

- C What are the influences and relationships between hydrologic processes and other ecosystem processes (e.g., sediment delivery, fish migration)?

- C What are the opportunities to manage hydrologic characteristics in order to maintain or enhance desired future conditions?

Stream Channels

Issues

Alteration in stream channel morphology and function may have occurred. Potential causal agents for these alterations include: modifications of the stream flow regime, changes in sediment delivery, removal of riparian vegetation, alteration of large woody debris and complex structure on the flood plain and in the channel. Some channels may have been altered by installation of bridges and culverts or by operating heavy equipment in or adjacent to the channel.

Key Questions

- C What were the historical morphological characteristics of stream valleys and general sediment transport and deposition processes?

- C What are the current conditions and trends of stream channel types and sediment transport and deposition processes prevalent in the analysis area?

- C What are the natural and human causes of change between historical and current channel conditions?

- C What are the influences and relationships between channel conditions and other ecosystem processes (e.g., inchannel habitat for fish, water quality)?

Water Quality

Issues

Land management decisions will maintain and protect water quality. Quality of water refers to inherent characteristics of the water body in question and the uses and users of the water. The State of Oregon is responsible for establishing the uses (called beneficial uses) and standards applicable on all waters in the state, as well as the monitoring and enforcement of these standards. The State of Oregon also regulates the legitimate users of water resources through a system of water rights.

Key Questions

- What were the historical water quality characteristics of the analysis area?

- What beneficial uses dependent on aquatic resources occur within the analysis area? Which water quality parameters (e.g., ph, dissolved oxygen) are critical to these uses?

- What are the current conditions and trends of beneficial uses and associated water quality parameters?

- What are the natural and human causes of change between historical and current water quality conditions? What are the influences and relationships between water quality and other ecosystem processes?

- What opportunities exist to:

    1) manage streamside vegetation to improve stream temperatures?

    2) improve road/trail drainage to reduce sediment delivery to streams?

Fish Species and Habitats

Issues

Resident fish, non-resident fish, Oregon chub, pacific lamprey, and trout inhabit streams in the Benton Foothills analysis area. Habitat for fish and other aquatic species has been degraded and/or is declining in condition. Habitat problems include a lack of large woody debris, quality pools, complex system of side channels, and proper substrate. The Oregon chub has been federally listed under the Endangered Species Act; the headwaters to critical habitat are managed by BLM. The pacific lamprey is a federal candidate species.

Key Questions

- C What were the historical relative abundance and distribution of species of concern and the condition and distribution of their habitats?
- C What are the relative abundance and distribution of species of concern that are important in the analysis area (e.g., threatened or endangered species, special status species, species emphasized in other plans)? What are the distribution and character of their habitats?
- C What are the current habitat conditions for the species of concern?
- C What are the natural and human causes of change between historical and current species distribution and habitat quality for species of concern? What are the influences and relationships of species and their habitats with other ecosystem processes?
- C What are the opportunities to manage habitats in order to maintain or enhance desired future conditions?

Wildlife Species and Habitats

Habitat Issues

The landscape has been converted from an older forest habitat in the uplands and oak savannah in the foothills into a fairly homogenous stand of younger aged Douglas-fir. Currently, less differentiation exists in stand ages.

Habitat Key Questions

- C What was the historical condition and distribution of habitats?
- C What are the current distribution and condition of habitats?
- C What is the current landscape pattern with regard to composition, origin, edge, patch shape and size, connectivity, and patchiness?
- C What is the current level of standing snags and downed coarse woody debris and their recruitment?
- C What are the current amount and condition of special habitats within the analysis area?
- C What are the natural and human causes of change between historical and current habitat distribution and condition?

C What are the opportunities to manage habitats in order to maintain or enhance desired future conditions?

Species Issues

Special Status Species (Threatened and Endangered Species, Survey and Manage Species, SEIS Special Attention Species) must be considered when any federal action is taken that may affect the species or the habitat upon which they depend (Endangered Species Act).

The watershed is not identified as an important elk area, though the welfare and management of big game and other native wildlife species is recognized. The primary goal of the Willamette Valley National Wildlife Refuges is to create optimal habitat for wintering dusky Canada geese.

Species Key Questions

C What was the historical abundance and distribution of species?

C What is the existing distribution and relative abundance of special status species and their habitat?

C What is the existing distribution and relative abundance of special attention species and their habitat?

C What is the existing distribution and relative abundance of species and their habitat for which there are social goals?

C What are the natural and human causes of change between historical and current species distribution and habitat quality for special status, special attention, and species for which there are social goals?

Human Uses

Commodity Forest Products

Issues

Under the Northwest Forest Plan, Matrix lands in the analysis area are to be managed for production of a sustainable supply of timber and other forest products while protecting other resources.

Key Questions

- What were the historical patterns of forest product use?

- What are the current conditions of commodity forest products (commercial timber and special forest products)?

- What level of future timber/special forest products harvest can be sustained in the Matrix lands for the next 10-20 years while still supporting the goals set for other resource levels?

- What silvicultural practices or other methods will be necessary to attain the desired future conditions of LSR lands and promote Matrix objectives in the analysis area?

Transportation Management

Issues

The transportation system within the forested uplands was originally constructed to facilitate timber harvest and provide access to scattered homesteads. Early construction standards for roads and stream crossings left legacies that, on occasion, have contributed to adverse environmental conditions. Over time, however, these roads have stabilized. With proper maintenance, they will present little risk to the environment. BLM is limited in road closure opportunities by existing reciprocal rights-of-way agreements with industrial forest landowners on the majority of existing roads.

Key Questions

- What were the historical transportation patterns?

- What are the current conditions of the transportation system?

- Does the condition of roads in the analysis area meet future needs of the transportation system?

- How can we manage the transportation system to meet Aquatic Conservation Strategy objectives?

- What is the process to evaluate new road construction in order to meet Aquatic Conservation Strategy objectives?

Recreation

Issues

The recreational activities within this analysis area are dispersed and undeveloped. No recreational uses have been encouraged but instead have evolved from interested public. Other than the forest roads constructed for management activities, no federal facilities have been constructed. Those roads do, however, serve the recreating public by providing access for hunting, collecting special forest products, pleasure driving, and serving as a means of reaching trailheads for motorcycles and mountain bikes. Basically, recreation is an unmanaged use of these public lands. As use continues to increase, however, it will need to be better monitored.

Key Questions

- What are the major recreational resources and uses within the analysis area? Where do the uses generally occur?

- How have recreation resources been developed and/or used since early settlement?

- What are the current conditions of recreational resources in the analysis area (e.g., overuse of limited resources, user conflicts, multiple use conflicts, and any other management concerns)? How much are these resources being used by the public? What are possible future trends in resource conditions and public use?

- How and why have recreation resource conditions and uses changed since early settlement? What are the influences and relationships between recreation resources and uses and other ecosystem processes?

- What recreation management actions (recommendations) are needed to address recreation issues in the analysis area?

Land Tenure

Issues

All of the BLM land in this analysis area is designated in the RMP as Land Tenure Zone 2. In this zone, tracts can be exchanged to create larger blocks in Zones 1 and 2. Several of the smaller tracts may be suitable for exchange to help block up in Matrix lands.

Key Questions

- C What areas in the analysis area have significant resource values that would benefit from land tenure adjustments?

- C What tracts in the analysis area should remain under BLM administration to protect significant resource values?

Rural Interface Areas

Issues

Rural residential areas are located on several roads which provide access to public lands. Some residents in these areas have expressed concerns about the impacts of BLM resource management activities and public use on their quality of life, property values, health and safety. BLM needs to give careful consideration to the interests of rural residents when planning and implementing activities.

Key Questions

- C Where are the rural residential areas in the analysis area?

- C What is the history of rural residential concerns?

- C What are the current concerns of rural residents?

- C What management guidance needs to be developed to address these concerns?

Chapter 3&4 - Reference and Current Conditions

Soils

A. Reference Conditions

Soil productivity in this analysis area was largely determined by soil organic matter levels and soil nitrogen levels (availability of trace minerals was also important). Soils on steep slopes and ridgetops (>1,750 feet) had lower organic matter levels than at lower elevations. This was due to the rate of erosion exceeding the rate of deposition, less available water for plant growth and to the higher return frequency of fire. Soil nitrogen levels were maintained by additions through precipitation, nitrogen fixing plants, and decomposition of dead plant material and organic matter in the soil. Soil nitrogen levels likely declined following severe fires, or complete removal of trees, ground cover and duff at intervals less than 90 years.

Soil compaction, except for a few trails from humans and animals, is assumed to be minimal prior to 1850.

A background level of soil displacement occurred as a result of landslides and surface erosion influenced by climatic conditions such as heavy rainfalls, windstorms and other factors.

Erosional processes that occurred prior to 1850 are assumed to be the same as those that occur today. Watershed hillslopes intercepted water and routed it to channels. Watershed health was directly related to the condition of the soil and associated vegetation on these slopes which affected the contribution of soil and water to streams. Natural hillslope erosion processes affected the delivery of soil sediments and water to streams. Prior to 1850, soils in the region and watershed probably varied in their characteristics, behavior, and productive capacity just as they do today. This variation was primarily due to differential resistance to weathering of soil parent materials which influences slope gradients and shapes, and for a given climatic zone, has the greatest impact on soil types.

Erosional processes are not assumed to vary between pre and post-1850. Prior to 1850, erosional characteristics of the analysis area (e.g., the intensity and rate of landsliding and surface erosion) were likely different than they are today, due to manipulation of the analysis area - primarily road construction, timber harvest and the cessation of broad scale burning. Data on the intensity and timing of landsliding prior to 1850 is largely absent. We may infer from current data that the overall intensity and rate of landsliding was probably less than we see today (see Current

Conditions section). The rate of landsliding in areas experiencing severe fires or wind throw events prior to 1850 would be similar to that measured today in areas where root strength has been severely reduced by severe fires or clear cut harvesting.

In the past as in the present, surface erosion would, in large part, be influenced by the amount of vegetation and debris present on a given site, the angle of the surface (% slope), the porosity of the soil and condition of the surface as relates to the infiltration rate, the water storage capacity of the soil (affects how quickly the soil profile saturates) and the number of freezing - thawing and wetting - drying cycles in a given time period (affects rate of dry ravel). Prior to 1850, the frequent, low intensity fires conducted by the native peoples in the valley and foot hill areas probably had minimal effect on surface erosion rates in those locations. The primary vegetation, grass and forbes, recover quickly following a low intensity fire so that the soil surface was well protected by the time the winter rains set in. The topography in these areas was gentle so dry ravel was not a factor and surface run off rates were slow. Undoubtedly there were times when the intentionally set fires escaped into steeper areas of the analysis area and likely resulted in intense fires. Significant increases in surface erosion likely occurred for a period of several years. As vegetation re-established and stabilized a given site, the rate of surface erosion would return to pre-disturbance levels.

Erosional processes are discussed in more detail in Appendix 2.

A summary of the primary factors affecting soil erosion and compaction in this watershed prior to 1850:

C Streams originating in the slump earth flow terrain (about six square miles southeast of Flat Mountain) are rapidly down cutting their channels in response to stream grade adjustment following land form changes due to mass soil movement (slumps). This increases the rate of erosion compared to stable hillslopes, (Dietrich and Dunne 1978). Impacted streams are: Reese, Beaver, Richard and Gleason Creeks and their tributaries.

C Hillslopes with slope gradients >60% are subject to high erosion rates from surface erosion and mass wasting (Swanson and Grant 1982). About 200 acres of BLM lands in the analysis area are affected.

C Studies show a close relationship between hillslope gradient and soil surface erosion. The average hillslope gradient in this watershed is low. Less than 1% of the analysis area has slope gradients in excess of 60%. In this analysis area, low sediment yields probably existed compared to other watersheds with higher average slope gradients.

C Generally, surface soils in this watershed contain 50 to 70 percent silt and clay size particles. Once suspended in water they settle out slowly, so tend to be carried out of the watershed during high flows. Due to the high percentage of very small, colloidal size particles, the release of soil colloids to streams occurs year around and gives a “milky” appearance to water in streams. This is particularly true for soils in the lower portion of the analysis area.

C Most of the streams in the analysis area are flowing in channels containing unconsolidated sands and silts and lack hard rock. This results in channels that are not armored with rock and are easily eroded during bank full stream flows. Historically, live and dead vegetation played a very important role in armoring these channels.

C Climate in the analysis area is cool and moist. This provides for high biomass production and rapid regrowth after low intensity fires and other natural events. Surface soils were thus protected by vegetation fairly continuously over long periods of time.

Conclusion:

Due to the general low relief of most of the analysis area, the small area of slump earth flow and slide prone terrain, and the high biomass production, the historic erosion rates and sediment yields have been low compared to adjacent watersheds to the west in steeper terrain.

B. Current Conditions

Soils in the watershed have been impacted by cultural activities associated with settlement and resource extraction beginning around 1850 and continuing to this day. The following activities have reduced soil productivity: 1) soil compaction and/or displacement from ground-based yarding equipment; 2) scarification and site preparation; and 3) organic matter losses from soil displacement and slash burning. The most serious productivity losses from compaction occur on the most productive lands where timber management activity is concentrated. Soil productivity losses from soil displacement and depleted organic matter occur on shallow and moderately deep soils. Any activity that reduces organic materials on these soils will result in a reduction of soil nutrient levels. The TPCC data show about 40 acres of shallow gravelly soils. Approximately 306 acres of soils on BLM lands have suffered some productivity loss from logging.

Prior to the 1940s, logging was done primarily with steam donkey / cable systems, the logs being yarded to railroad sidings then transported by railroad to the mill. Trees on ridge tops were rigged with cables to provide support for long distance yarding of logs. This system required few access roads. Other than gouges in and near ridges from the passing logs, there was minimal soil compaction and displacement elsewhere. Approximately 3,000 acres of BLM land, concentrated in the western third of the analysis area, were logged this way.

During the 1940s and 50s, large areas were logged using crawler tractors. This required close access road spacing and closely spaced (~100') skid roads. Access and skid roads were often placed in or along side drainages and on steep hill sides. Impacts to soil productivity from compaction and displacement was high. In some areas much of the stream-side vegetation was damaged or removed as well, resulting in significant quantities of soil entering stream channels directly or in runoff. Since that time, hillslopes and riparian zones have revegetated. It is likely that considerable amounts of sediments, generated from logging, still remain in the stream system, and portions of this sediment move through the system whenever there are high stream flows. One study suggested a residence time for fine sediments in first order mountain streams to be 19 years and considerably longer in higher order streams (Dietrich and Dunne 1978). It is likely that a part of the turbidity present in streams during high flows is attributable to movement of these "old" sediment deposits originating from past logging activities.

About 5,900 acres have been yarded by ground-based equipment during the past 50 years in the analysis area. (Dyrness and Swanson 1973) reported that about 35% bare soil and 26% compacted soils are typical for areas yarded by ground-based equipment. Since the 1970s, steeper terrain and operating restrictions have greatly reduced the use of ground-based equipment on BLM lands. Beginning around 1980, most of the soil compaction in new harvest areas has been mitigated so that less than 12% of the harvest area has compacted soils.

Skid roads and many old access roads are unsurfaced. OHV and motorcycle use is active in this analysis area and is concentrated on these old "dirt" roads. This activity has prevented many of the old roads from revegetating and they are a chronic source of sediment to streams.

A summary of the primary factors affecting soil erosion and compaction in this analysis area from 1850 to the present:

C Railroad and steam donkey logging had little impact on soil erosion and caused minor amounts of localized soil displacement and compaction.

C Roads and clearcuts caused eight hillslope failures identifiable on aerial photos taken between 1950-1993. Four of the eight slides were present on the 1950 photos so must have occurred prior to that date. The remaining four slides occurred between 1950-1978. All of these slides have revegetated.

C Tractor yarding occurred on steep and moderate slopes resulting in deep gouges on some hillsides. Some yarding occurred in and adjacent to first and second order streams. These actions resulted in accelerated erosion of fine sediments into the streams. Much of the material moved through the system quickly, but significant sediment deposits remain trapped behind logging debris and vegetation in the channels and flood plains. During bank full and higher events, some of this material is moved further through the system resulting in high turbidity. In some locations vegetation has stabilized the old deposits.

C Many of the old roads are dirt surfaced. Several of these and some old skid roads are presently being used by motorcycle and OHV users. While the total area impacted by this activity is low, the impact to streams can be high when highly turbid runoff flows into adjacent streams.

C Approximately 1,530 acres in the analysis area have been compacted from past logging activities. Detrimental effects from compaction on growth of Douglas-fir can last in excess of 50 years (Power 1974) with total volume yield reductions up to 40%.

C Much of the timber in the analysis area is of commercial size. Harvest activities in the analysis area are expected to increase. This will result in construction and hauling activities on new and existing roads. This disturbance, as well as yarding activity, is predicted to increase the erosion potential in the analysis area. When in close proximity to streams, each disturbance may result in increased sediment entering the streams for a period up to five years.

Vegetation

A. Reference Conditions

Fire has been the primary large-scale disturbance factor influencing vegetation in the Oregon Coast Range. The nature of the Coast Range forests prior to 1900 was largely determined by the intensity, frequency, and extent of the natural fire regimes associated with particular areas (Walstad et al. 1990; Agee 1993). The predominance of Douglas-fir in this region at the time of Euro-American settlement was largely due to disturbance by fire as well as the longevity of this species (Agee 1991). Catastrophic fires occurring at intervals of 150-400+ years likely affected the upper (western) portion of the Benton Foothills analysis area similar to, but in smaller patch sizes, than in other areas of the Coast Range. The lighter rainfall in this analysis area (due to the rain shadow effect of the Coast Range) may have resulted in more frequent, less intense fire.

Prior to the advent of Native Americans in western Oregon, the analysis area likely consisted of more extensive stands of Douglas-fir/Grand fir types in the valley floor portions of the Willamette Valley. Johannessen et al. (1971) asserted this view arguing that trees, when allowed to, grow well on Willamette Valley soils and that subsequent burning by Native Americans artificially generated and maintained prairies.

Burning by Native Americans is widely documented (Boyd 1986, Zybach 1988, Agee 1993, Mintonye 1968, Towle 1982) and impacted the analysis area. Prior to Euro-American settlement in the 1840s, Native Americans inhabited the Willamette Valley at least as far back as 10,000 years ago (see Human Uses section). Kalapuya and Klickitat Indians inhabited the analysis area during its earliest recorded history. These Indians managed vegetation and game habitat in the Willamette Valley by burning. Annual burning of many areas of the valley and foothills was common practice up until the 1850s. The frequent burning reduced or eliminated trees and brush over wide areas. In the xeric moisture zone (<1000 feet elevation), a savannah with scattered oak, maple and Douglas-fir was the predominant vegetation type resulting from frequent burning. An excerpt from a settler's account of the 1840s around the town of Alpine and Bellfountain describes the scene: "fir timber was in the high mountains to the West not in the valleys. Grass was shoulder high, only a few Oakes and maples on low hills." (Mintonye 1968). Another paragraph from the book describes the result of settlement and curtailment of burning: "The view was soon changed when they put fences around their meadows. Brush grew quickly in those fence rows."

With all the burning taking place in the low lands during pre-settlement times, some fires probably burned into the uplands, especially under east wind conditions. Occasional fires in the uplands, particularly on drier south and west slopes, probably resulted in some fairly open woodlands with low forest-floor fuel loadings. The trees in this open woodland most likely had larger, horizontal limbs than normally found in tighter, more densely stocked stands with higher fuel loadings. Under extreme weather and fuel conditions high intensity stand-replacing fires did occur in some areas of the analysis area. With scattered open stands in the uplands, a probable result would be less extensive stand-replacement fires and smaller patch sizes in this analysis area compared to interior coastal forests. The 1901 and 1936 type maps for this area show a mosaic of timber stands of various age classes and stocking levels in the western half of this analysis area which gives support to this concept. The 1936 map also documents some eastward advancement of the general forest edge resulting from fire exclusion.

The estimated percentage of late-seral forest in the Coast Range prior to the 1840s was 61% (Ripple 1994). Due to the large proportion of area in the xeric zone and the effects from valley burning in the Benton Foothills, the percentage of late-seral forest in this analysis area may have been lower, perhaps in the 20 to 40 percent range. (A best estimate from available maps indicated 31% in mature forest at the turn of the century). At any single point in time, depending on how large an area is analyzed and on the frequency and intensity of fire events, the range could have been 0 to 100 percent of the forest in late-seral stage. This is especially likely when smaller areas are considered. As previously stated, the condition of the forests in the Benton Foothills analysis area prior to the 1840s is thought to have been more open than generally observed in wetter portions of the Coast Range. The eastern extent of the forested area is also known to have been less by as much as 3 to 4 miles.

A recent, yet unpublished study (1996), conducted by John Christy of the Oregon Natural Heritage Program attempted to document vegetation for the year 1850 in the Muddy Creek area (which closely approximates the Benton Foothills analysis area; Map 4). Vegetation types and their approximate percentages within the area included: prairie (dry and wet) - 42%; oak savannah - 15%; mixed stands - 13%; Douglas-fir/white oak - 10%; Douglas-fir/western hemlock - 6.5%; Douglas-fir - 5%; sparse Douglas-fir woodland - 4.5%; and the remaining in wetlands and valley floor riparian forests.

Special plant communities such as wetlands and dry meadows occurred within the analysis area prior to the 1840s, but in an unknown amount and condition. Wetlands were probably greater in extent than currently observed due to more recent (since 1840s) drainage activities. The ecological and physical processes that produced these communities are assumed to be the same as those that are occurring now. For a discussion of these ecological and physical processes, refer to Appendix 3.

B. Current Conditions

Fire

The natural fire regime across the Coast Range landscape has been greatly influenced since settlers began moving into this region in the mid-1800s. With settlement also came logging. These two factors have had a major effect on the seral stage distribution, species composition, patch size, and spatial configuration of the current forests in the watershed. In the last 50 years, the incidence and effect of wildfires within and around the Benton Foothills analysis area has been minimal as fire suppression policies have acted to minimize all non-prescribed fire.

Over several decades, the absence of both wildfires and the burning of pasturage for livestock has resulted in the natural transformation of the "fern openings" and mountain top "grassy balds" back to forest. This transformation can be observed at many locations throughout the analysis area. The forest edges are encroaching upon the open areas, converting them from grass, ferns and low shrubs back to forest. In some areas, this process has been hastened by planting of conifers by landowners.

Prescribed fire has been the preferred method for treatment of logging slash and brush following clearcut harvests. In some respects, the logged units can be compared to past catastrophic fire events. The patch size of these modern "stand replacement events" has corresponded to that of harvest units. On federal land, over the past three decades, clearcut units have ranged from about 10 to 70 acres, with 30 acres being about average. On private and state lands, the unit size is generally much larger, often exceeding 100 acres, with an average around 50 acres. Smoke management restrictions have steadily forced reductions in unit size, fire intensity (tons/acre consumed), and total acres burned. Twenty years ago, nearly all burning was done in the fall when the large fuels were dry, resulting in high fuel consumption and severe effects on soil and coarse woody debris. Since about 1980, the preferred burning season has shifted to the spring, resulting in much less impact to these resources. In the first half of this century, extensive and fairly contiguous logging created large open patches and left behind significant amounts of cull material and large snags. Many of these areas were subsequently burned over. These early large contiguous burns could be considered a much closer replication of natural processes than the more recent practice that produces smaller harvest units and lower coarse woody material levels. However, some amount of smaller patches, as replicated by modern logging practices, would seem to fit with the past conditions for this analysis area as earlier described under reference conditions. The recent practice of leaving significant numbers of standing trees and snags along with down logs in harvest units results in conditions that closely match what would be left following a natural fire of moderate to high intensity. Average size of the harvest units on federal land is now too small to replicate expected natural conditions, but opportunities exist within the limits of ownership boundaries to adjust size upwards if desired. Any such actions would need to consider actual and expected harvest on adjacent private lands.

Overall, acreage burned in the decade of the 90s has fallen, due in large part to smoke management constraints and rising costs. Many units, especially on private land, are now planted following harvest with little or no treatment of the slash. Large blocks of unburned fuel accumulations do pose an increased risk for a large fire event in the future that could spread into mature timber reserves on federal land. The emphasis on leaving snags and down logs on federal land will increase rates of spread and resistance to control of any fires that do start. Previously burned clear-cut units, roads, and the general patch work nature of stands within the analysis area may somewhat mitigate this increasing fire risk.

Forest Health Considerations

The current forest health conditions in the Benton Foothills analysis area are considered within the probable range of historic conditions (see Salem District RMP/EIS 1994). Disease and insects are natural components of the watershed. Various root diseases occur within the analysis area (including known occurrences of *Phellinus weirii* (laminated root rot)) but have not had significant effects on stand mortality. Historically, insects have not been a significant problem, although windstorms may increase insect problems such as the Douglas-fir bark beetle. Tree yellowing due to nitrogen deficiencies has been observed in this analysis area and may be related to soil types.

Vegetation

The current composition and seral age class of the vegetation summarized across all plant communities is shown in Table 1. Agricultural grass/pasture dominates the vegetation within the analysis area (26.8% of land base). The forest vegetation classes within the analysis area reflect a combination of vegetation types (e.g. conifers, hardwoods, grass/forbe) and seral stages (roughly equivalent to age-classes) within a vegetation type. Conifer forests between 50 and 70 years of age comprise the next largest vegetation class (21.3%) within the analysis area followed by wetland riparian with trees (7.8%), 10-40 year conifer (7.7%), agriculture/Christmas trees (7.5%), shrub/sapling (5.7%), 80-120 year conifer (4.4%), 50+ year mixed conifer-hardwood stands (3.8%), grass/forb recent harvest (3.4%), 50+ year hardwood (2.9%), and 10-40 year mixed stands (2.8%). It is important to note that the oldest conifer seral stages (forest stands >80 years old) currently represent only about 5% of the analysis area, while the younger conifer seral stages (forest stands less than 80 years old including recent harvest units and shrub/sapling forest plantations) account for almost 35% of the analysis area. When just considering BLM-administered lands, 50-70 year-old conifers are the dominant type (47%) followed by 10-40 year-old conifers (22.7%), 50+ year-old mixed stands (8.7%), and 50+ year-old hardwoods (7%) (Map 5).

TABLE 1. ACRES AND PERCENT OF VEGETATION CATEGORIES WITHIN THE BENTON FOOTHILLS ANALYSIS AREA

Vegetation Category	Total Watershed (Acres)	% Total Watershed	% of Total BLM Land
Open-Urban, Quarry, Settlement	25	0.03	0
Open-Bare Ground (Recent Harvest)	1,193	1.5	.001
Agriculture - Row Crop	875	1.1	0
Agriculture - Grass, Pasture	21,615	26.8	0
Grass/Forbe - Recent Harvest	2,766	3.4	0
Agriculture-Christmas Trees	6,062	7.5	0
Agriculture-Vineyard	117	0.1	0
Oak Savannah	388	0.5	0
Shrub/Sapling - Persistent or Natural Shrub	413	0.5	0
Shrub/Sapling - Forest Plantation	4,594	5.7	3.6
10-40 Yr Conifer	6,190	7.7	22.7
50-70 Yr Conifer	17,204	21.3	47.0
80-120 Yr Conifer	3,510	4.4	3.8
130-190 Yr Conifer	462	0.60	3.50
200+ Yr Conifer	20	0.02	.2
10-40 Yr Mixed	2,252	2.8	.001
50+ Yr Mixed	3,085	3.8	8.7
10-40 Yr Hardwood	402	0.5	2.7
50+ Yr Hardwood	2,414	2.9	7.0
Wetland - marsh	466	0.6	0
Wetland -riparian with trees	6,295	7.8	0
Open Water	299	0.4	0.8
Total	**80,647**	**100.0**	**100.0**

The current condition of forested vegetation is that of greatly reduced structural diversity and species composition. This is due primarily to previous activities such as: 80-year rotations, leaving only two snags per acre after regeneration harvest, retaining small buffer zones of 80 feet (in contrast to the Northwest Forest Plan), prioritizing harvest on oldest stands, and removal of suppressed trees, downed woody debris, snags (safety hazard), and minor species. The general condition of vegetation with respect to wildlife needs is discussed in the Wildlife section.

The current trends are improving conditions for the composition of older forest stands as well as structural diversity. This is largely due to the adoption of the Northwest Forest Plan. Industrial forest lands in the analysis area are continuing to be managed on 40 to 60 year rotations dependent on the owner.

Plant association types are useful in predicting the potential effects of timber management actions and in determining possible silvicultural prescriptions for the site. The valley fringe areas which comprise much of the analysis area are not described in the plant association guide (Hemstrom and Logan 1986) used by the Siuslaw National Forest and typical of intermingled BLM lands. The Benton Foothills analysis team described the plant associations within this analysis area as follows:

- The Valley Zone is found on the Willamette Valley floor and adjacent to and intermingling with the valley associations on warm, dry sites at elevations less than 1,000 feet. Landforms include rolling foothills in addition to the valley floor areas. Annual precipitation ranges from 50 to 60 inches. Root-zone soil temperature remains above freezing during the winter months. Evapotranspiration exceeds precipitation beginning in late April. The soil moisture deficit is about 10 to 12 inches. Turnover rate of organic matter is rapid. Soils are dark reddish-brown and gravelly on the hillslopes and clayey on the colluvial slopes. Biomass production is moderate to low.

  Major conifer species include Douglas-fir and some grand fir. White oak, big-leaf maple, red alder, and madrone are predominant deciduous trees. Shrubs include poison oak, hazel, ocean spray, snowberry, and Oregon grape. Poison oak is especially indicative of this zone. Most of these sites have experienced frequent fires.

  Management concerns in this zone are primarily related to limited soil moisture during the growing season and to plant competition. Seedlings growing in fine-textured soils are stressed during the spring when the transpiration rate exceeds available moisture to the roots. Available moisture in gravelly soils is used early in the season. Only drought-tolerant vegetation is suited to this zone.

- The Foothills zone is found in the intermediate elevations (1,000 to 2,000 feet) of the analysis area. Landforms are steep hillslopes and rolling colluvial slopes. Annual precipitation ranges from 60 to 70 inches. Root-zone soil temperatures remain cold into April. Evapotranspiration exceeds precipitation beginning late May or early June. Soil moisture deficit is about 6 to 10 inches. The turnover rate of organic matter is moderate.

Soils are dark reddish-brown on the older colluvial surfaces, dark brown and loamy on the younger surfaces, and dark reddish-brown and gravelly on the steep hillslopes. Biomass production is moderate to high.

Major conifer tree species include Douglas-fir, western hemlock, and western red cedar. Red alder and big-leaf maple are present in varying amounts. Red alder grows on exposed mineral soil. Predominant shrubs are red huckleberry, salal, vine maple, and blackberry. The herb layer, when present, is dominated by swordfern and oxalis. Plant communities vary depending on the impact and presence of marine airflows across the Coast Range. Drier sites have more ocean spray, snow berry, and herbaceous species than wetter sites.

There are few management concerns in this zone. Competition for light occurs along streams and stream-adjacent slopes and in areas of topsoil disturbance. Soils on ridgetops are deficient in nitrogen at higher elevations.

C Uplands Zone - The Uplands Zone is found primarily between 2,000 and 3,000 feet elevation. This zone is most often found on flats and broad ridgetops. Annual precipitation ranges from 80 to 200 inches. This zone is within the transition snow zone. Soil temperatures remain cool throughout the year. Evapotranspiration exceeds precipitation in early June. The soil moisture deficit is 4 to 6 inches. Turnover rate of organic matter is slow. Soils are brown and gravelly. Biomass production is moderate.

Major conifer tree species include Douglas-fir, western hemlock, and western red cedar. Red alder and big-leaf maple are present in varying amounts. Red alder grows on exposed mineral soil. Predominant shrubs are red huckleberry, salal, vine maple, and blackberry. Rhododendron and beargrass may occur on ridgetops. The herb layer, when present, is dominated by swordfern and oxalis. Plant communities vary depending on the impact and presence of marine airflows across the Coast Range. Drier sites have more ocean spray, chinquapin, and herbaceous species than wetter sites.

Management concerns are primarily related to the short growing season. Soil nitrogen levels are typically low. Soil A horizons are typically thin. Most of the organic matter is concentrated at or near the sol surface. The soil productive capacity is easily impacted by practices that remove, compact or disrupt the topsoil. Cold soil temperatures delay bud burst in conifers to late May or early June. Plant competition from red alder, big-leaf maple, or salmonberry is expected to be minor except in moist areas or disturbed sites.

Several special plant communities exist in the Benton Foothills analysis area including seasonal and permanent wetlands, wet and dry meadows (grass balds), and/or shallow soil/rocky areas. These special plant communities offer unique habitats for both plants and wildlife, increasing the diversity of the analysis area. However, the extent of these habitats in the analysis area is poorly understood. Preliminary estimates for BLM-administered lands, based on TPCC data, are as follows: 20.4 acres of seasonal wetlands (including some riparian hardwood communities); 7.2 acres of permanent wetlands; 11.5 acres of surface water; and 38.7 acres of shallow soil/rocky areas which may include some dry meadow areas. Estimates for private lands are based on studies conducted by the Univ. of Oregon (Hulse 1997). These are shown as part of Table 1.

Special Status Species

No threatened or endangered species are presently known to occur within the Benton Foothills analysis area. No known Bureau sensitive or assessment species presently occur.

Special Attention Species

Appendix 4 lists the likelihood of occurrence for Northwest Forest Plan ROD species within the Benton Foothills analysis area. These species are to be protected by the application of survey and manage procedures, as designated in the Northwest Forest Plan. Several ROD species have been located within the analysis area as follows:

> *Fungi - Cantharellus cibarius, Clavulina cristata, C. subalbidus, C. tubaeformis, C. formosus, Clavariadelphus sp., Endogone oregonensis, Gymnopilus puntifolius, Helvella maculata, Hydnum repandum, Otidea onotica, Phaeocollybia ssp., Ramaria sp. Sparassis crispa, Thaxterogaster sp.* nov. # Trappe 4867, 6242
>
> *Lichens - Lobaria oregana, L. pulmonaria, Nephroma helveticum, N. laevigatum, N. resupinatum, Peltigera pacifica, Pseudocyphellaria anomola, P. anthraspis, P. crocata, Sticta fuliginosa, S. limbata.*

A complete understanding of the current condition is unavailable for many of these species, particularly the non-vascular plants (lichens and bryophytes) and fungi. The following factors have contributed to our limited knowledge about these species:

C Survey and inventory has predominantly been limited to vascular plants.

C Sightings are few and widespread for some species, indicating large gaps in range information.

C Only the most rudimentary of ecology data is available for many species; therefore, habitat requirements are essentially unknown for most of these species.

C Sighting location information is often general, lacking specific information.

Unique or Uncommon Plants

The Benton Foothills analysis area contains plant species that are considered uncommon and of special interest. Some of these species are protected under the Oregon Wildflower law (State of Oregon 1963) which makes it unlawful to export or sell or offer for sale or transport certain plant species. Some of these species likely to occur in the analysis area include: *Calochortus* spp., *Calypso* spp., *Erythronium* spp., and *Rhododendron* spp.

Noxious Weeds

Certain invasive plant species, listed as Noxious Weeds by the Oregon Department of Agriculture (1994), are known to occur in the Benton Foothills analysis area. These include: Canada thistle (*Cirsium arvense*), bull thistle (*C. vulgare*), Scotch broom (*Cytisus scoparius*), St. Johnswort (*Hypericum perforatum*), and tansy ragwort (*Senecio jacobaea*). Canada and bull thistles, St. Johnswort and Scotch broom are well established and widespread throughout the Marys Peak Resource Area. Eradication is not practical using any proposed treatment methods. However, treatment emphasis will be biological control agents. Populations of tansy ragwort have been partially contained as a result of these efforts. Populations primarily occur in disturbed areas, such as along roadsides and on landings.

Private vs. Public Lands Considerations

Private forest lands within the analysis area will be managed in accordance with the state of Oregon's Forest Practices Act (OFPA) standards in place at the time of harvest. Private ownership in the Benton Foothills analysis area ranges from small woodlot managers to large corporate managers on forested land, and from small farms (e.g., pasture, Christmas tree production) to larger farm managers (e.g., commercial grass fields) on agricultural land. Rural residential areas also occur within the analysis area. Small woodlot management goals vary from owner to owner. Some lands may be managed on short regeneration harvest rotations and some by selective cut methods. The general trend on industrial forest lands within the analysis area is to manage all stands under a 40 to 60 year rotation and to control competing vegetation by the application of herbicides. On these lands, approximately two trees per acre are retained for use by wildlife. These trees are commonly located on the edge of units and/or next to riparian buffers. Under the existing OFPA standards, the riparian buffers may decrease in size (width) in the future. This is because riparian widths are based upon the amount of tree volume (especially conifer basal area) adjacent to the stream channel. As trees adjacent to the stream grow larger (volume increases), trees can be cut and consequently, riparian buffer zones may decrease in width.

Vegetation on public lands has been typically managed on short rotations (60 to 80 years) in the past. Approximately two snags per acre were retained for wildlife although this was not always achieved in harvest units; riparian buffer strips approximating 80 feet were retained. The primary factor impacting future vegetation patterns within the analysis area is the change in management direction on federal lands from timber production (primarily through clearcut harvesting) to the development of late-successional habitat.

Riparian Reserves

A. Reference Conditions

Riparian areas can be categorized as two general types. Along higher order streams with distinct flood plains and flood plain terraces, there are wide bands of riparian vegetation interspersed with meadows and other gaps. Hardwoods dominate areas with high water tables and those subject to frequent disturbance. Most of the riparian areas in the agricultural lowlands in the analysis area fit this description. A study of historic vegetation in the Willamette Valley, based on early accounts, found gallery forests along these streams consisting of hardwoods and Douglas-fir which were subsequently cleared by settlers (Johannessen 1970). A map of the vegetation in 1850 shows bands of ash and white oak/ash forests along Muddy Creek interspersed with wet and dry prairie. Large swamps occurred along Muddy Creek and at the confluences of Powell and Starr Creeks, Oliver and Larsen Creeks and Hammer and Nichols Creeks (Christy 1996, unpublished). Presumably, burning by the native peoples prior to European settlement prevented establishment of conifers in many riparian areas in the lower portion of the analysis area. Beaver trapping and draining by settlers probably eliminated the swamps.

The west portion of the analysis area, where most of the BLM land is located, is generally characterized by higher gradient, lower order streams. Flood plains are narrow and slopes are relatively steep, resulting in vegetation along the stream edge which is similar to that upslope. Although no one really knows what riparian vegetation consisted of before European settlement, one study found that red alder is rare along streams in undisturbed stands over 100 years old in the Coast Range, but common in logged stands (Minore 1994). Presumably disturbance by fire or flooding would favor colonization by red alder in small patches rather than in the large areas that are common after logging and road building. Ripple 1994 cites a study which claims that only 3.5% of the stands in the Coast Range prior to the 1840s were less than 100 years old. Therefore it is likely that hardwoods and conifers in early seral stands occupied a small percentage of riparian areas, although we do not know the percentage.

Late-seral forest in the analysis area prior to 1850 was between 20 and 40% of the land base, due to xeric conditions and the effects of valley burning (see discussion in the Vegetation section). Stands located in the interior portions of the analysis area, as well as along streams, were likely at the higher end of the estimate. Ripple (1994) cites a source which found that third- and fourth-order streams in the Coast Range had a large number of old-growth patches due to wet conditions and lack of human use. Conversely, riparian areas around first- and second-order streams likely experienced more disturbance from fire due to conditions similar to the uplands. Therefore, stands on interior north facing slopes along third-order and higher streams most likely had the highest number of late seral and old growth patches, and riparian stands in the foothills and savanna on south facing slopes probably had fire disturbance at shorter intervals and more early seral patches. Most riparian areas lie between these two extremes, presumably with older forests averaging about 40% of the land area.

B. Current Conditions

Vegetation Composition and Distribution (Map 6)

Seral stages on private and BLM land were analyzed using Oregon's Forest Practices Act (OFPA 1997 revised) riparian management buffers and Federal Riparian Reserves respectively, as shown in Table 2.

TABLE 2. SERAL STAGES IN FEDERAL RIPARIAN RESERVES AND OFPA RIPARIAN BUFFERS

Seral Stage	BLM Riparian Reserve Acres	% of Total BLM Riparian Reserves	Other Federal Riparian Reserve Acres[1]	Private Riparian Acres	% of Total Pvt Riparian Acres
Early Seral (0-30 years)	722	27	6	354	17
Mid Seral (40-70 years)	1343	51	4	340	16
Late Seral (80-199 years)	141	5	0	533[4]	3
Old Growth (>200 years)	6	<1	0	<1	<1
Hardwood[2]	432	16	0	135	6
Non-forest	11	<1	56	534	25
Special Habitat[3]	0	0	116	717	33

[1] USFW and USFS
[2] Hardwood includes red alder and red alder/Douglas-fir stands, mostly found in the interior areas.
[3] Special Habitat includes marshes and riparian bottomland, forested with some combination of ash/willow/cottonwood/red alder/Douglas-fir/grand fir, mostly found in the agricultural lands.
[4] late seral riparian hardwoods (ash/willow/cottonwood/red alder)

The current riparian vegetation in the agricultural lowlands is mostly nonforest, except along Muddy Creek and Reese Creek. Over 75% of the private riparian management buffers in the foothills and interior consist of early and mid seral stage stands. The 3% of private riparian management buffers classified as old growth are actually late seral riparian hardwoods. Riparian Reserves constitute 43% of BLM land in the analysis area, and 3% of the total analysis area (Map 1). Riparian Reserves were mapped using slope distance (Appendix 5). Most BLM ownership is in the foothills and interior upland portion of the analysis area where conifer stands predominate. Riparian vegetation is characterized by lack of late seral and old-growth habitat.

Stands older than age 80 account for only 5% of BLM Riparian Reserves. Seventy-eight percent of the Riparian Reserves are composed of conifer stands less than 80 years, and hardwoods make up 16%.

If 40% of the Riparian Reserves in the analysis area were historically over 80 years in age, then the current stands are outside the range of natural variability. About 83% of the BLM Riparian Reserves consist of conifer stands which will eventually develop older forest characteristics. However, Federal ownership within the analysis area is limited to a small percentage of the total acres, and total late seral riparian habitat is expected to remain low.

With the implementation of the 1997 revised OFPA, streamside riparian protection buffers are now required on private and state owned lands. Protection widths vary depending upon stream type and size. The new rules restrict cutting in some riparian areas, allowing trees growing within 20 feet of streams to remain uncut. However, because mandated buffer widths are much less than those required on federal land, wide corridors with older forest characteristics will not develop on private lands (Map 7).

Sixteen percent of BLM Riparian Reserve acres consist of hardwoods and mixed hardwood/conifer stands. These stands range from narrow bands along streams to wide areas where red alder has seeded in after logging. It is probable that the mixed conifer/hardwood stands will develop into older riparian forests. In areas where pure hardwood stands are associated with salmonberry, or where hardwoods overtop most conifers, it is possible that succession will proceed to brush dominated sites rather than to conifers (Tappiener 1991).

Stand Structure and Composition

Riparian stands with older forest characteristics such as large trees, diverse species, multi-layered canopies, snags and decaying down wood, and scattered open patches are generally lacking in the analysis area and will take a long time to develop without further management. Stands in the mid-seral stage account for about half of BLM Riparian Reserves. Most of them were logged and allowed to seed in and are generally uniform even-aged Douglas-fir stands, with a minor component of other conifers and hardwoods in the same canopy layer. A few large old growth trees are left from the logging operations, but only about 6% of the mid-seral stands are classified as having an understory. Although no formal coarse woody debris surveys have been done in the Riparian Reserves, informal reconnaissance of some stands indicates that many logs and snags were left as a result of logging. These down logs and snags are now in decay class three through five. Stands generally lack younger coarse woody debris and snags.

Connectivity (Map 8)

BLM Riparian Reserves have no connectivity to older forests to the east of the analysis area as the analysis occurs at the edge of the Willamette Valley. To the west, Oliver Creek in T.13S., R.8W., Sec.25 connects with Riparian Reserves in the South Fork Alsea watershed. Riparian Reserves and Late-Successional Reserves in Oliver Creek in T.13S., R.7W., Sec.31 and Peak Creek in T.14S., R.7W., Sec.7 also connect with Riparian Reserves and LSR in the South Fork Alsea Watershed. As Riparian Reserves and Late-Successional Reserves age and begin to develop older forest characteristics, a contiguous block will develop along the west boundary of the analysis area connecting with the South Fork Alsea watershed.

Stream Temperature/Bank Vegetation Shade (Map 9)

Although stream temperatures are influenced by a range of processes, shade provided by bank vegetation can be an important factor during periods of low flow. Riparian vegetation within 10 meters of streams was looked at for age and species composition on Federal and private land (Table 3). All streams occurring in stands over age 10, including hardwood dominated sites, were considered to be at low risk for increased stream temperatures due to lack of shade. Sixty-nine percent of the streams on BLM and private land are within this category. Only four percent of the streams on BLM land are considered at high risk. Streams at high risk occur in greater numbers in the eastern portion of the analysis area where they generally flow through agricultural and other non-forested lands.

TABLE 3. RISK FOR HIGH TEMPERATURES AT LOW FLOW DUE TO LACK OF SHADE

Current Condition					
RISK	BLM ACRES[1]	% OF TOTAL BLM	OTHER FEDERAL ACRES[2]	PRIVATE ACRES	% OF TOTAL ACRES
LOW	429	96	59	1778	69
HIGH	18	4	57	807	31
		Trend			
LOW	417	93	59	2029	78
HIGH	30	7	57	564	22

[1] All acres in Table are within 10 meters of stream
[2] All "Other Federal Acres" represents the Finley Wildlife Refuge

Lack of streamside shade is not a problem in the forested portions of the analysis area. Because of the OFPA regulations which generally prohibit cutting within 20 feet of a fish-bearing stream, the forested foothills and interior portion of the analysis area are moving toward having more streamside trees and lower risk. Riparian vegetation in the agricultural lowlands in the eastern portion of the analysis area will remain generally the same, therefore risk for high stream temperature due to lack of shade will remain relatively high.

BLM land within 10 meters of streams is currently within the range of natural variability for streamside vegetation shade and will remain so, because almost all high risk BLM land is now in early seral conifer regeneration, and no further regeneration harvesting will done within 10 meters of streams. The projected slight increase in high risk acres is based on the presumption that without management, a portion of hardwood acres on BLM land will succeed to brush rather than to conifers or more hardwoods. It is assumed that private industry will eventually convert most of their riparian hardwoods sites to conifer, where possible.

Large Woody Debris Potential in Streams (Map 10)

Vegetation within 30 meters of streams in the analysis area was classified by composition and age on Federal and private land (Table 4). Large woody debris in the stream is recruited from within 30 meters of the stream (FEMAT 1993), and the best quality (high potential) large woody debris is considered to be conifers over 80 years old. Lower Muddy and Upper Muddy subwatershed basins were excluded from this analysis because their riparian areas were historically dominated by hardwoods. Presumably most conifer large woody debris in streams in those subwatershed basins came from the upland in floods and debris torrents.

TABLE 4. LARGE WOODY DEBRIS RECRUITMENT POTENTIAL IN STREAMS[1, 2]

Current Conditions					
POTENTIAL	BLM ACRES	% OF BLM TOTAL	OTHER FEDERAL ACRES	PRIVATE ACRES	% OF PRIVATE
LOW	595	45	3[3]	2,951	48
MODERATE	641	49		2,816	46
HIGH	81	6		333	6
Trend					
LOW	272	21	0	4,396	72
MOD/HIGH	1,045	79	3	1,704	28

[1] excluding Upper Muddy and Lower Muddy SWB
[2] acres within 30 meters of streams
[3] all other "other federal" land is located in the Lower Muddy Subwatershed basin

Large woody debris potential for the whole analysis area is currently low because the Riparian Reserves lack stands older than 80 years. Six percent of BLM land in Riparian Reserves has high large woody debris potential which is the same as for private land. Moderate large woody debris potential which includes mid-seral conifer, and mid-seral and older hardwood stands constitutes about half of the Riparian Reserves.

The trend for BLM lands is toward high large woody debris potential in most Riparian Reserves. For private lands, because of different riparian regulations, the trend remains for a lower percentage of lands with a high large woody debris potential. For the analysis area as a whole, combining BLM and private lands, the trend is for approximately 37% of the riparian areas to have a high large woody debris potential.

The 272 acres of BLM Riparian Reserves which are presumed to have low large woody debris potential in the future are hardwood stands which are considered low quality large woody debris in streams.

Hydrology

A. Reference Conditions

Hydrologic processes during the Holocene are assumed to be the same as those currently observed. Streamflow in the Benton Foothills analysis area likely varied in this period with short (annual to decadal) to long term (century to millennia) climatic patterns in interaction with the natural disturbance regime (fire, rain and wind storms, disease, earthquakes, etc).

Drier climactic periods likely resulted in a tendency towards reduced peak flows, flooding, and summer base flow (due to reduced levels of water storage). These conditions may have been partially offset by increases in the frequency and/or the intensity of wildfires in response to drought conditions. Wildfires, which dictated the primary patterns of disturbance in forested regions, burned the hillslope vegetation and set the stage for major erosion events (mass wasting and surface erosion) and altered the baseline hydrologic conditions.

Large reductions in vegetational biomass following these fires may have helped augment (as a result of reductions in evapotranspiration) the reduced summer base flows. Reductions in surface infiltration may have resulted from baked soil surfaces, producing earlier and larger peak flow events. Simultaneously, while the stage was set for increases in sediment production and delivery to streams through mass wasting and surface erosion, this was likely offset by reductions in the size and frequency of storm events which precipitate mass wasting and provide the stream energy to transport the eroded material.

During wetter periods the situation was reversed; higher precipitation resulted in a tendency towards higher base flow, peak flow events and flooding. However, these tendencies may have been partially offset by the accompanying reductions in wildfire and its disturbance effects during wetter periods.

Hydrologic conditions in the Muddy Creek mainstem are strongly influenced by flows in the Marys River and Willamette River. During flood events Muddy Creek, due to its extremely low gradients, has a tendency to back up as higher stage in the Marys River produces a damming effect, or backwater. Historically, before major channel alterations in Marys River and the Willamette had occurred, these tendencies were likely to be longer lasting, and flooding and swamping of the Muddy Creek lowlands was likely greater in extent and duration. In addition, tributary channels to Muddy Creek were likely to have been subject to greater flooding and higher water tables prior to channel alterations which accompanied settlement (see Stream Channels section).

B. Current Conditions

Water Resources in Muddy Creek

Stream discharge on a 107 square miles portion of the Muddy Creek drainage just above Corvallis was gaged from 1919 to 1968. For the period of record (1964-1968), the average mean annual discharge for Muddy Creek was estimated at 205 cubic feet per second (cfs), or approximately 2 cfs/square mile. By contrast, the Alsea River watershed, just west of Muddy Creek, averages over 4 cfs/square mile. Over 50% of the annual flow came in the months of November though February. Monthly mean flows ranged from a low of about 1.4 cfs occurring in late summer, to a high of 1,000 cfs during typical winter months. Maximum monthly flows generally occurred during the months of December, January, and February. Extreme flows for the period of record ranged from a low of 2,100 cfs to a peak discharge of 6,040 cfs on 12/22/64.

Groundwater resources are concentrated in the unconsolidated sediments deposited adjacent to Muddy Creek and its tributaries (USGS 1974). Approximately 30,000 acres (38%) of the surface geology in Benton Foothills is of this type, predominately on private lands. Aquifers in this material are capable of yielding moderate to large (as much as 500 gpm) quantities of water to wells, sufficient for irrigation purposes. In 1974 it was estimated that these deposits in the Corvallis-Albany area stored 750,000 acre-feet of water at depths between 10 and 100 feet. The quality of this water was generally good with the exception of some evidence of coliform bacterial contamination. The Muddy Creek uplands, including the majority of forested lands, are on an underlying base of fine-grained sedimentary and volcanic rock of low porosity and permeability which significantly limits ground-water resources. These rock types have small pockets of perched water which can yield low quantities of water capable of supplying domestic water but are insufficient for irrigation. Some of this water is high in soluble minerals and of poor quality as a source of drinking water.

Peakflow

Significant flood events have occurred historically on a fairly regular basis throughout Western Oregon (Bodhaine 1961). The Muddy Creek river gauge recorded 10 peak events between 1920 and 1968, the largest on 12/22/1964 with a peak discharge of 6,040 cfs, or 56 cfs/square mile. For comparison, the same event resulted in a peak discharge of 41,800 cfs on the Alsea River at Tidewater, or 125 cfs/square mile. A halving of peak discharge/unit area in Muddy Creek, just over the drainage divide from the Alsea River, is attributable to lower precipitation and a small transient snow zone in the Muddy Creek watershed.

Transient Snow Zone and Peak Flows

Unlike many watersheds in western Oregon, Muddy Creek peak flow events are not likely to be driven by rain-on-snow. These events are produced by a rapid and substantial depletion of the snow pack in the "transient snow zone", estimated to average approximately 1,800 feet in elevation. Below this elevation, precipitation is predominately rainfall. Approximately 1,400 acres (1.7%) of the Upper Muddy Creek watershed lies within the transient snow zone (Map 11). Of this area, 613 acres (44% of the total) are in the headwaters of Beaver Creek on Flat Mountain. The remaining transient snow zone is located on Green Peak and along a small ridge line above Hammer Creek.

Although the transient snow zone constitutes a very small area even in Beaver Creek (4% of the acreage), this zone is particularly vulnerable to extremes in storm events and is an area of higher risk for road construction and timber harvest.

Forest Management and Discharge

While controversy continues to surround the issue of forest management effects on stream discharge, the most recent research in the region argues that peak discharge in harvested basins the size of Muddy Creek display increases of as much as 100% (Jones and Grant 1995). These increases are attributed to changes in flow routing due to roads and changes in water balance due to treatment effects and vegetation succession. In addition, studies have found long term reductions in summer baseflow in managed basins; attributed to alterations of riparian vegetation and the degradation of flood plains and wetlands.

No analyses of peak flow increases or reductions in summer baseflow in Muddy Creek were conducted for this analysis. However, the Soils section of this analysis indicate that the forested uplands have been altered by extensive harvesting, compaction and displacement of surface soils and road construction. As a result, the timing and quantity of peak flows are likely to have been altered from reference condition in Muddy Creek; no attempt has been made to quantify this effect. Future iterations of watershed analysis for Muddy Creek may employ computer modeling to test this hypothesis.

Reductions in baseflow resulting from conversion of riparian vegetation and the degradation of channels, wetlands and flood plains have also likely occurred, although these effects are concentrated in the depositional reaches in the agricultural lowlands. The following sections summarize current conditions in the forested uplands that are likely to effect stream discharge.

Roads and Peak Flow

Highest road densities occur in the Upper Greasy Creek area with 8.5 mile/square mile followed by Moss Creek with 6.5 mile/square mile (Figure 2) (includes road system, overgrown roads, and OHV trails). Seventy percent of total road mileage exists in the four sub-basins with the greatest concentration of forest management: Beaver Creek, Hammer Creek, Oliver Creek, and Reese Creek with 122, 92, 97, and 57 miles of road respectively. Thirty-four miles of road (1% of total road length) are currently located within riparian zones (based on interim riparian widths). Fifty percent of these (16.9 miles) are in Beaver Creek sub-basin.

An average of 3.5 mile/square mile of road exists on the BLM lands within the analysis area. The Aquatic Conservation Strategy requires that these roads be closely evaluated for their impact on aquatic functioning and considered for closure/decommissioning (see Transportation section). Approximately 0.5 mile of road is currently located on moderate to high risk landslide terrain in the Upper Muddy Creek. These sections of road on BLM have been inventoried and evaluated as candidates for closure/decommissioning (see Transportation section).

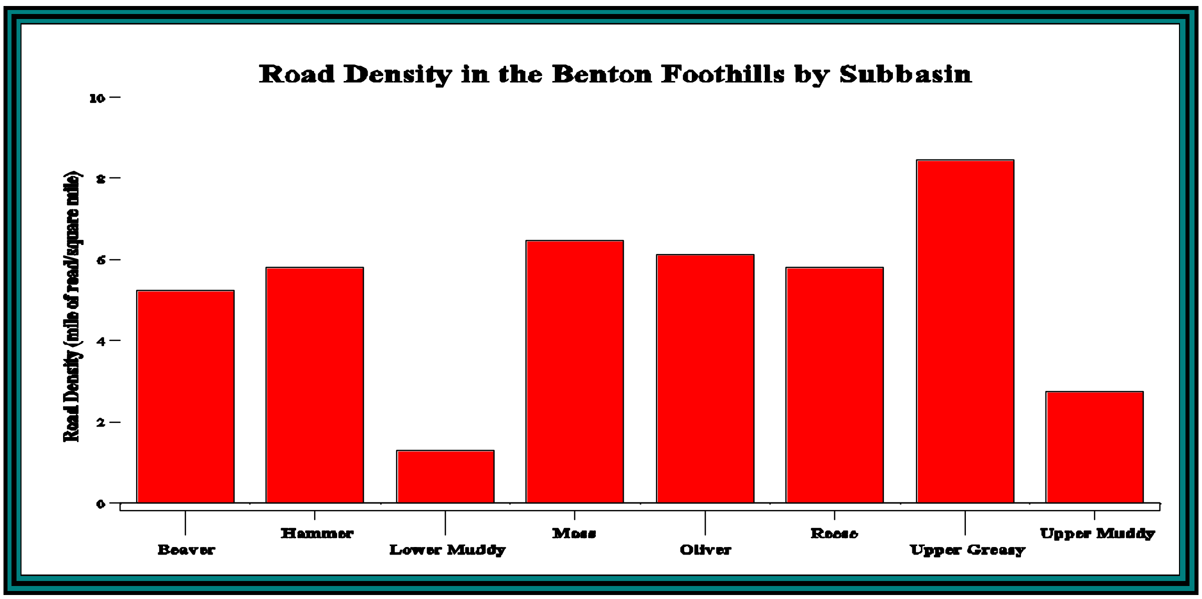


Figure 2. Road Densities in the Analysis Area

Extension of the stream network at road intersections is cited as the principal causal agent in the alteration of peak flow timing and amplitude (Jones and Grant 1995). Mechanisms of channel extension include the capture and routing of precipitation and snow melt from compacted road surfaces to streams, and the interception of groundwater at road cutbanks and subsequent routing to streams. Effective channel lengths appear to have increased by 70 miles (17% overall within Muddy Creek). This is a conservative estimate compared to the overall 57% increase in effective stream length measured in a study on forested lands in the Cascades (Wemple 1994). Confidence in this estimate is low due to the use of a generalized factor (400 feet extension/stream crossing), overcounting of private road mileage, and the lack of field verification.

Vegetation and Discharge

An additional element implicated in the alterations in the timing and amplitude of peak flows is the temporary conversion of mature forest to early seral stage vegetative cover following harvest. The mechanisms most often cited for this effect are the reduction in evapotranspiration, increases in surface flow, and increased snow packs associated with openings. These effects are expected to last approximately ten years. Currently, 17,590 acres (22%) of the Upper Muddy Creek are in an early seral vegetation class (Figure 3). If only the forested acreage is considered, 35% is in an early seral growth stage. Beaver Creek sub-basin has the greatest total (4,060 acres, 37%) early seral class vegetation while Hammer and Upper Greasy have the highest percent early seral (48 and 45, respectively). Thus nearly half of the forested portions of Hammer Creek are in early seral age class vegetation.

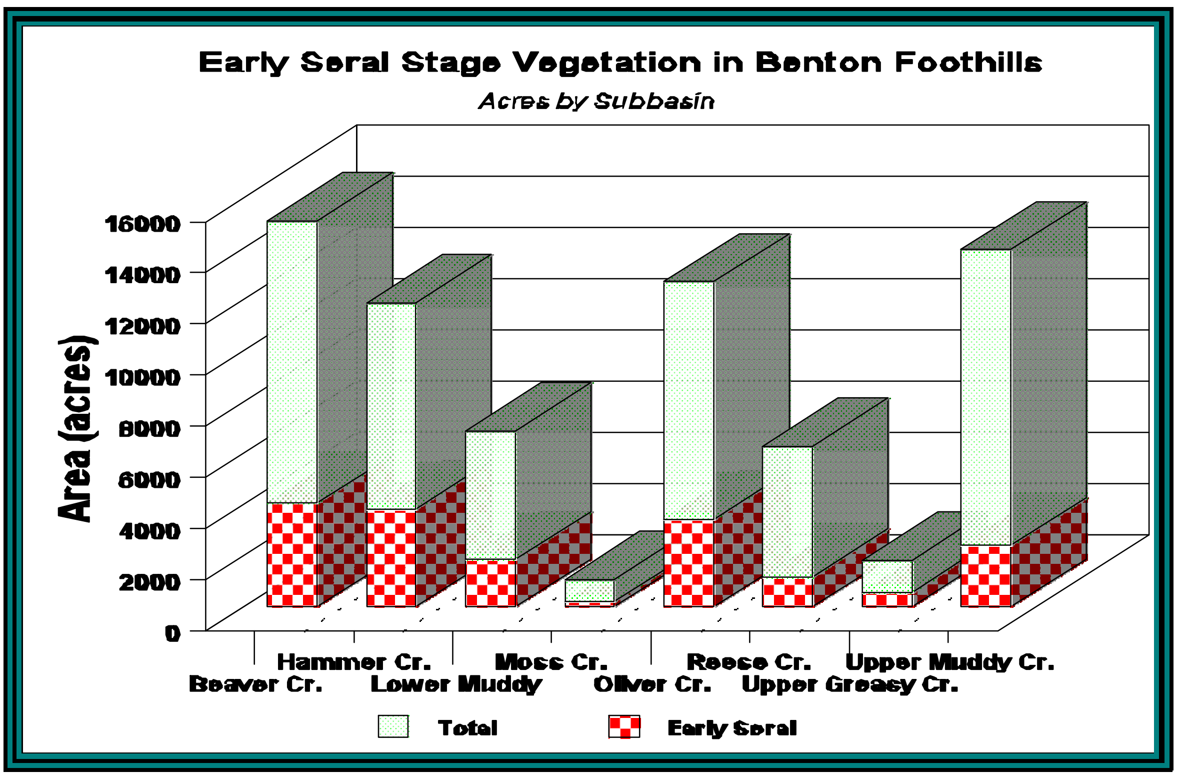


Figure 3. Early Seral Stage Vegetation in Benton Foothills

Baseflow

At the Muddy Creek gaging station, average monthly flows in August from 1964-68 were 3.7 cfs (approximately 0.022 cfs/square mile average unit base flow in August). This is an extremely low average unit base flow as demonstrated by comparison with the North Fork Alsea at 0.40 cfs/square mile and even 0.06 cfs/square mile on the Long Tom River at Monroe prior to the dam (base flow increased to 0.22 cfs/square mile following the construction of the Fern Ridge Reservoir). The lowest recorded base flow on Muddy Creek was 0.7 cfs measured on the 23rd of August, 1966.

Base flow in Muddy Creek has likely been reduced from reference condition as a result of channel and flood plain degradation. Much of the Muddy Creek watershed's extensive wetlands and flood plains appear to have been highly altered from pre-settlement conditions (see Channel Condition section). Hypothetically, the area is vulnerable to measurable reductions in summer base flow as a result of these alterations, but pre-settlement data are not available to confirm this.

In addition to the low summer baseflows of Muddy Creek related to seasonal fluctuations, two legal components, water rights and minimum flow requirements, significantly diminish the availability of natural flows. The volume of water involved in these rights and diversions has resulted in conflicting demands for the available resource, particularly during the low flow season.

Water Withdrawal Rights

Oregon State's water appropriations doctrine is based on first-in-time/first-in-right. Holders of water rights are granted priority dates corresponding to the date of application. These rights are held as long as state requirements continue to be met. The state requires that a use or withdrawal right be directly applicable to a designated beneficial use. For Muddy Creek, beneficial uses of surface waters include: domestic water consumption, fisheries, agriculture (including irrigation and livestock), recreation, wildlife, fire control, and power. As of March 1997, active surface water rights in the Muddy Creek River system as a whole totaled approximately 85cfs. Although there are withdrawal rights for domestic consumption on all the major Muddy Creek tributaries, most rights are for irrigation. There are no municipal surface water rights in this watershed.

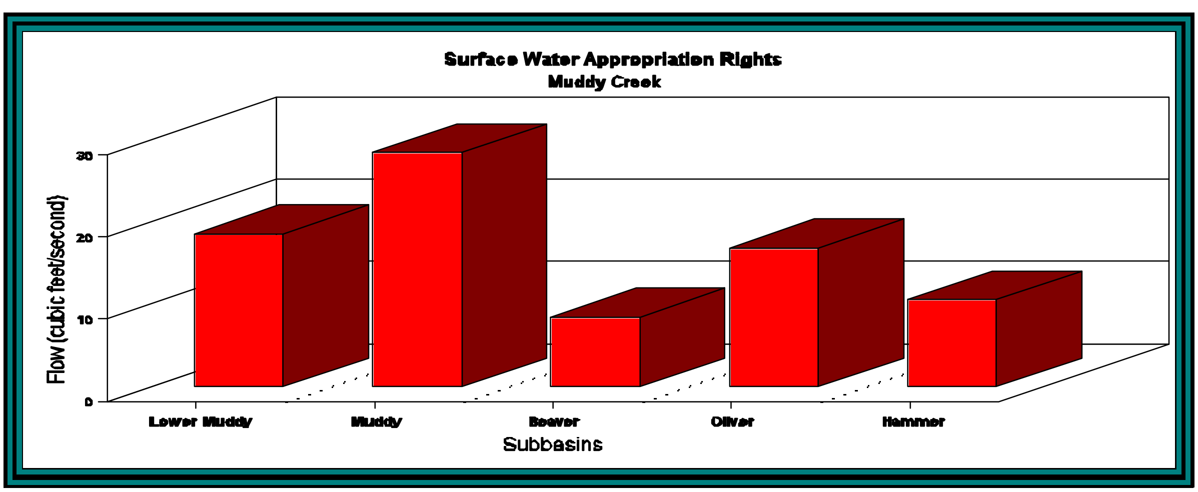


Figure 4. Surface Water Appropriation Rights by Stream

In June 1966 the Oregon State Water Resources Board (now the Water Policy Review Board) established minimum flow reservations "for the purpose of maintaining a minimum perennial streamflow sufficient to support aquatic life and recreation." All water rights granted after the June 1966 date are subject to the minimum flow reservations. This has resulted in the appropriation and utilization of essentially all available streamflows on Muddy Creek during the late summer and early fall period of critical years. During drought years, water appropriations on Muddy Creek likely exceed base flow capacity.

Confidence in the Analysis

Conclusions concerning hydrologic effects of historic management are hypothetical and are based on professional estimate, deduction, and extrapolation. Overall, the material in this section is adequate for broad planning purposes. Site specific data and recommendations are necessary to apply conclusions from this section to specific projects.

Stream Channels

A. Reference Condition

Historically, the processes which control stream channel morphology and sediment transport are assumed to be the same as those currently observed. Characteristics of stream channels and sediment transport in the Benton Foothills analysis area are also likely to have varied during the Holocene in response to climatic conditions interacting with natural disturbance patterns.

Drier periods, with significant reductions in precipitation, likely resulted in a tendency towards channel aggradation (increased storage of sediment and organic material in the channel) which probably resulted in pool filling, an increase in braided channels, and flood plain deposits. Increased sediment supply was likely offset by reduced streamflow competence (ability to transport material) due to reductions in peak flow events. This likely resulted in an overall dampening of variability in channel conditions and a slow down in the process rate. During wetter periods, the inverse situation was likely with a tendency towards increased variability, faster rate of processes, and a tendency toward channel cutting. Former flood plains were abandoned as streams mobilized and transported earlier deposits, entrenched into the stream bed, and cut banks.

These processes were further altered in a spatial dimension. The lowlands along Muddy Creek are essentially a wetland and have an overall tendency (due to the low gradients and unconfined setting) toward storage of water with accompanying fine sediment deposition on flat alluvial flood plains and in the channel. Stream velocities were low, water tables high throughout the year and the potential for pools, backwaters, and alcoves was substantial. These conditions dampened seasonal variability and resulted in highly stable and diverse aquatic habitat (both in channel and on the adjacent flood plain) in the Muddy Creek mainstem and its adjacent tributaries. Low stream energy and high water tables likely buffered disturbance events and maintained stable conditions. These conditions were likely to be highly conducive for beaver colonization. Beaver dams further reduced stream velocities, sediment and water movement through the system while increasing flooding, channel cutting and meander. Dams were also highly influential for aquatic habitat types and conditions. Due to the depositional nature of this area, it is likely to be highly susceptible to alterations in the chemistry of incoming sediment and water.

As you move upchannel to higher gradients conditions slowly alter. Alluvial flood plains at the base of Flat Mountain and Green Peak resulted in meandering channels with the development of alternating cut banks and sand/gravel bars. Stream energy was greater, substrates larger (sand to gravel), and seasonal variability increased with energetic peak flows and annual flooding of adjacent plains during winter while soils slowly drained during the summer drought to maintain a stable, cool, and slow base flow regime. These channel types are inherently sensitive to disturbance or changes in the precipitation, sediment and discharge regime. They are particularly sensitive to alterations of vegetation on stream banks and in the flood plain with a tendency towards incision and bank erosion when disturbed.

Upland channels formed in response to higher gradients and the accompanying increase in stream energy while interacting with local soils and surface geology. On the steep face of deep rotational slump material, common in the uplands of Beaver Creek, channels are steep, "V" shaped and incised in the deep, silty-clay loam soils. Overtime, a balance between stream energy and the erodible substrate was achieved and these channels formed a 'stair step" structure making use of large downed conifer and boulder substrates that could not be transported. On the flat surfaces of these slumps, small mountain wetlands developed with deposition of fine sediment, high water tables and sluggish flow. Beaver and LWD were important influences on these low gradient, montane wetlands. Both of these channel types are highly sensitive to alterations in the vegetation on adjacent hillslopes and large conifer in channel.

On more cohesive bedrock, such as occurs in the headwaters of Oliver Creek and Reese Creek, channels likely cycled through an aggraded, sediment and large woody debris choked condition to a degraded, bedrock form in response to hillslope adjacent disturbance regimes. The largest source of stream substrates was ravel from over-steepened hillslopes whose foot had been removed by stream erosion. Large conifer entered the channel or lodged just above it following intense storm events with high winds and several inches of rainfall. Over-steepended ephemeral channels failed during such events and debris torrent material sluiced them to bedrock before being deposited at their right-angled confluence with second or third order perennial streams. Here the material choked the channel creating backwaters which trapped gravel sized substrate and produced further hillslope cutting. Eventually, the material was slowly reworked and transported downstream or was released suddenly during a catastrophic peak flow event. Where several choke points coalesced, such as at the confluence of two or more high gradient second order channels, flats formed from the accumulated colluvial material. These areas were often colonized by beaver whose structures helped raise water tables and provided highly desirable habitat for some fish species. Hardwood species and western red cedar were especially well adapted to these small, montane depositional areas and helped maintain the unique nature of this riparian-stream habitat.

B. Current Condition

Channel Morphology and Classification

In general terms, the movement of surface water, sediment, and organic material can be predicted by dividing the stream network into "source", "transport" and "response" reaches (Map 12) following the classification of Montgomery and Buffington (1993). Source reaches have gradients ranging from 8% to greater than 20%, and are found primarily in head walls and along steep side slopes. These reaches, due to their frequency and position on the landscape, are the primary source for much of the water and inputs of organic material, nutrients and sediment in the stream system. They have no flood plain development or stream banks, commonly flow intermittently or in response to storms, and the riparian area is typically dominated by conifer.

The sensitivity of source reaches to disturbance varies widely with local surface geology and soil types (Table 5). Sediment and organic material enters these channels through episodic landslides, chronic inputs of surface sediment in the form of "ravel", and soil creep and slumping (see Soils section). Periodic, catastrophic disturbances in these reaches are typically a normal part of the watershed ecology in the coast range and critical processes in the maintenance of the aquatic ecosystem (Benda 1990).

TABLE 5. STREAM TYPES AND SENSITIVITY TO DISTURBANCE

Stream Type	Sediment Supply	Riparian Vegetation	Peak Flows
Source	Low-High	Low-High	Low-High
Transport	Low	Moderate	Low
Response	High	High	High
Depositional	Extremely High	Extremely High	Extremely High

There are 219 miles (54% of total stream mileage) of source reach stream channels in the analysis area; 49 miles (22% of the total) of these are on BLM managed lands (Figure 5). The current functional condition of source reaches on BLM lands in the analysis area is largely unknown because they are rarely investigated and no standard criteria for establishing condition on these channels is available.

Transport reaches have a relatively high gradient (4-20%), are often resistant to changes in stream morphology, and tend to act as conduits for material from high gradient reaches to depositional and response reaches. These reaches typically have a cascade morphology, a large cobble or boulder substrate, and resistant banks with little or no flood plain development. They may be intermittent or perennial. Riparian vegetation is variable but tends to be dominated by conifer. There are approximately 67 miles (17% of total stream mileage) of transport reach stream channels in the analysis area**;** 7.2 miles (11% of the total) are on BLM lands. As with source reaches, the current functional condition of transport reaches on BLM lands is largely unknown.

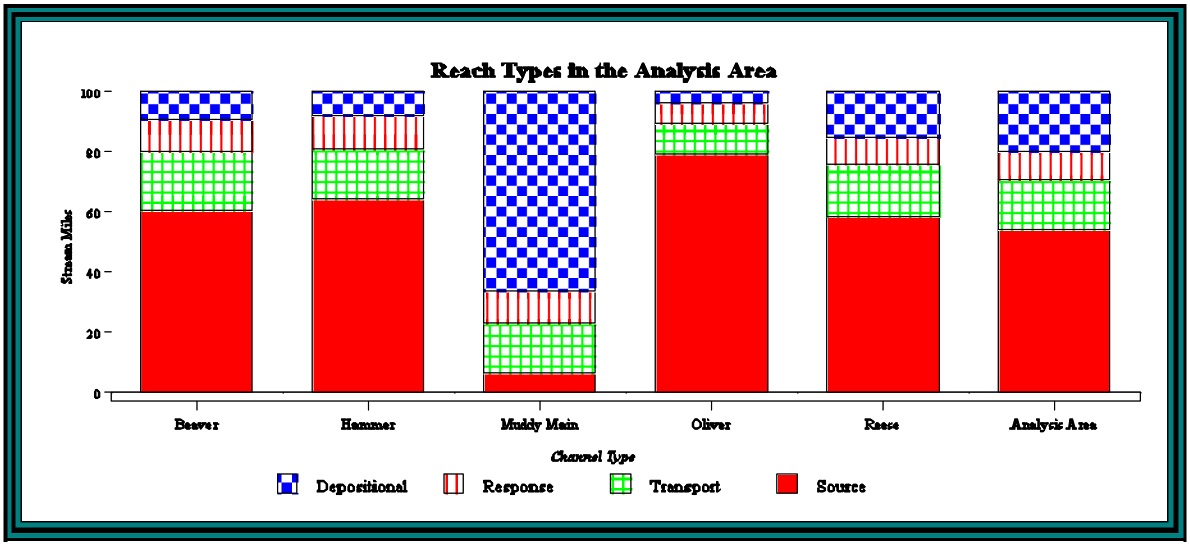


Figure 5. Reach Types in the Analysis Area

Field investigations to date indicate that source and transport channels in the forested uplands likely have higher sediment loads and reduced roughness, particularly large woody debris, relative to reference condition (see Fisheries section). On stable channels, the main supply mechanism for sediment appears to be ravel from the adjacent, over steepened hillslopes. Some of this material, mostly gravel size, is retained primarily behind dams created by large woody debris. In many sections where large woody debris is uncommon, gravels are being quickly transported downstream through long sections of channel degraded to bedrock. The long-term trend (next 100 years) on these channels is for slow recovery to near reference condition as large woody debris increases and channels capture and retain more substrate.

Many transport and source channels on slump prone ground (primarily on the lower slopes of Flat Mountain) are aggraded and, in some cases, widening. Streamflow has incised deeply into the deep, fine textured soils in these areas resulting in gully type channels. Channels in these positions are particularly sensitive to the condition of vegetation on adjacent hillslopes and tend to have high concentrations of fine suspended sediment during storm events. The long-term trend (next 100 years) is for slow recovery to a new equilibrium as large woody debris increases and channels adjust to higher sediment loads.

Overall, historic forest harvest activities have (relative to reference condition) likely reduced concentrations of large woody debris, altered sediment storage and routing, and in some cases destabilized sensitive channels in the forested uplands. However, due to the relative stability of the uplands and the several decades of recovery time since this area was first logged and roaded, the trend on these channels is toward recovery to a functional level close to reference condition. Nevertheless, only a small percentage of these stream types were visited and additional investigation is recommended on a site specific basis during project planning (see Chapter 5).

Response reaches (gradients from 1 to 4% and moderately confined to unconfined) and depositional reaches (gradients <1%, unconfined) are areas of sediment deposition, stream meander, and high potential for diversity and abundance of aquatic habitat. These reaches can experience significant changes in stream morphology if sediment supplies increase, riparian soils and vegetation are disturbed, flow regime is altered, or channel elements (substrate, large woody debris, meander geometry, width-to-depth ratio, etc.) are disturbed.

Identifying response reaches that are sensitive to disturbance is important because these reaches are often the most critical as aquatic habitat. In addition, the high water tables, large inputs of nutrient rich organic material, and the protected valley settings of these reaches combine to produce diverse and productive riparian habitat on the flood plain. Finally, these reaches are critical for the buffering of stream flows (they reduce floods and support summer base flow) and the maintenance of water quality.

In general, reaches that are sensitive to changes are low-gradient, unconfined channels, in uncohesive alluvium (gravelly, sandy or sandy-loam soils) especially at confluences with transport reaches. Transport reaches often enter response reaches at nearly right angles. This, in combination with low gradients, rapidly reduces the stream’s ability to transport sediment and flows. Channel meander and flood plain development are the stream’s natural response to these conditions, and therefore, it is critical for the functioning of response reaches that proper channel geometry be maintained. The same elements that maintain stable channel geometry (substrate, large woody debris, meander geometry, width-to-depth ratio, etc.) are also critical for the maintenance of biological processes, and these areas are typically the preferred habitat for beaver and many species of fish.

There are approximately 40 miles (10% of total stream mileage) of response channels in the analysis area. The BLM manages one mile (<1% of the total) of response reach. A small portion of response reaches are on private lands in the forested uplands, but the majority cross through agricultural areas managed for grass and livestock production or small ranches and rural homes. It is critical for the maintenance of the aquatic ecosystem in the analysis area that these reaches be functioning properly, but based on limited field observations, most are probably in poor condition (see bank erosion investigation under the water quality section of this document). This has likely shifted aquatic populations to habitat on adjacent reaches where conditions are better, if less than ideal.

Qualitative field investigation indicated that most of these channels have been highly altered from reference condition. Much of this alteration probably occurred earlier in the century when the land was first managed for agricultural production. Most response channels are incised and moderately to highly unstable. Channels are "disconnected" from their flood plains (over bank flooding occurs only during extreme storm events, if at all) which now primarily function as terraces. Water storage in flood plains has been reduced, contributing to the reduction in summer base flows. The trend is for continued bank cutting and lateral instability as channels develop a new equilibrium. Full recovery to reference condition is unlikely.

Approximately 0.5 mile of response reach types on BLM were inventoried in the summer of 1996 (see Fisheries section). These channels appear to be competent and functional, although some disturbance of the adjacent riparian stands may have reduced large woody debris recruitment and shading on these reaches. The trend, under the forest plan, is for recovery to near reference condition on these channels.

The majority of depositional reaches, 81 miles (20% of total stream mileage), are on private lands managed for ranching and agriculture along the mainstem of Muddy Creek. The BLM manages no depositional reaches. These channels are probably aggrading (bed elevation is increasing as sediment deposits) and, likely, widening. Over bank (flood plain) flow occurs commonly as the channel adjusts to large sediment loads from tributary streams. Maintenance of riparian vegetation is critical to the stability of these channels. The trend is for continued lateral and horizontal instability in response to high sediment loads.

Confidence in the Analysis

Since this analysis was mostly office-based with few field visits, determination of stream types could only be completed qualitatively to a broad level classification. The categories cited in this analysis are general representations of the reaches described and may include shorter sections with different response potential. Channel gradient and entrenchment were determined using topographic maps followed by selected field visits, and channel response types were then determined from gradient classes. When possible, field verification was conducted. Existing stream surveys were used and extrapolated to similar channels in other parts of the analysis area when appropriate. Overall, the material in this section is adequate for broad planning purposes. Site specific data and recommendations are necessary to apply conclusions from this section on a project level.

Water Quality

A. Reference Conditions

Processes which determined water quality conditions during the Holocene are assumed to be the same as those currently observed. Characteristics of water quality in the Benton Foothills analysis area likely varied during this period in response to channel and hydrologic conditions as well as to climatic patterns in interaction with the natural disturbance regime.

Drier periods with significant reductions in precipitation likely resulted in a tendency towards decreases in stream flow, sediment transport, and vegetation shading the stream. This likely resulted in greater variability in stream temperatures (higher in summer, lower in winter) and lower variability in the sediment regime. Increased sediment storage, reduced flow velocities and increased temperatures likely resulted in a series of cascading effects on water chemistry and physical properties which likely affected the distribution and quantity of aquatic species.

Alternatively, wetter periods with increased stream flow and sediment transport, together with the resulting effects on stream channel and the morphology of riparian areas likely reduced stream temperature variability and pushed water chemistry and physical properties in the opposite direction. Sediment transport rates and stream turbidity would increase under these conditions.

These characteristics were further altered in a spatial dimension. The lowlands along the Muddy Creek mainstem had an overall tendency (due to the low gradients and unconfined setting) toward lower stream velocities, greater sediment storage, and a high amount of wetland habitats. This likely resulted in higher overall spatial variability in stream physical and chemical characteristics with open ponded areas of slack water differing from zones of faster moving water. However, temporal variability was likely dampened under these conditions. For instance, high water tables all year round and the long-term maintenance of a shaded stream canopy likely maintained stable stream temperatures with little annual and diurnal variation. Due to the depositional nature of these reaches, water chemistry was highly influenced by the chemistry of incoming fine sediment in combination with the general tendencies toward reduction in a flooded, low oxygenated system. Aquatic communities, consisting of both plants and animals, were likely to have heavily influenced and been influenced by water quality conditions in this area as the heavy inputs of organic materials accumulated.

Upstream in higher gradient, higher energy systems, water quality was less buffered from variations in response to disturbance events, and annual and diurnal climatic influences. Stream temperatures may have been in the high 60s along small channels whose riparian shade had been removed by fire. Pulses of sediment and leachable nutrients (i.e., phosphorous, nitrate, etc.) entered the channel during winter storms and when fires had increased their availability. During stable periods, nutrient concentrations were likely low and often a major limiting factor in the abundance of aquatic plant and animal life. Higher stream velocities and channel roughness generally kept the waters well oxygenated and the influence of vegetation and aquatic animals on water chemistry was probably small relative to the lowlands. Due to the nature of upland soils and surface geology in this area, streams were likely routinely transporting large quantities of fine suspended sediments which kept streams somewhat turbid or cloudy.

B. Current Conditions

The State of Oregon's water quality standards and rules to protect the designated beneficial uses of state waters apply to all streams in the Muddy Creek watershed including permanent, ephemeral and intermittent headwater streams under BLM jurisdiction. These standards are set forth in the Oregon Administrative Rules (Chapter 340, Division 41).

Water Quality Data Review

Water quality data reviewed for this analysis include:

1) The State of Oregon's Department of Environmental Quality (DEQ) is responsible for investigating, evaluating, reporting, and regulating water quality conditions in all state waters. DEQ publications which document current conditions (303d report, etc.) were reviewed (DEQ 1996).

2) The U.S. Environmental Protection Agency (EPA) has issued the BASINS software package which collected surface water quality data contained in the STORET database together with data on toxic sites (i.e., Superfund), permitted point sources, municipal watersheds, dams, etc. and placed these in an ARCVIEW software program for analysis and display (EPA 1996).

3) E&S Environmental Chemistry, Inc. of Corvallis sampled 10 sites in the watershed during the winter of 1996 for basic water chemistry and invertebrate diversity as indicated in their report prepared for the Cascade Pacific Resource Conservation & Development (E&S Environmental 1996).

Additional water quality data from private sources, state and private schools and universities, EPA, DEQ, or other public agencies may be available but were not located for this analysis.

303(d) list and "water bodies of concern"

According to the DEQ's 1996 303(d) list of water quality limited water bodies, no water quality standards are currently known to be exceeded on Muddy Creek or its tributaries, and Muddy Creek is not identified as being water quality limited. Similarly, Greasy Creek and its tributaries are not on the 303(d) list. However, Marys River, from the confluence of Greasy Creek to the Willamette River, is listed as water quality limited for summer stream temperatures, water contact recreation from fall through spring (due to fecal coliform contamination resulting from sewage treatment overflows during storm events), and flow modification.

The DEQ's 1988 assessment of non-point pollution identified Greasy Creek as a "water body of concern" due to excess sedimentation. This indicates that there is currently not enough data to either list Greasy Creek as water quality limited or to remove it from the list of active concern. The Marys River and Muddy Creek and its tributaries are not currently listed as "water bodies of concern".

"BASINS" Software review

There are four permitted waste water discharge sites, six water quality data collection sites, three U.S.Geological Survey (USGS) gage sites, two major municipal water supply sites, and one dam in the watershed. None of the permitted discharge facilities has been cited for discharges above their permitted limits. The major municipal watershed in the area is North Fork Rock Creek, tributary to Greasy Creek above Philomath, which provides water for the City of Corvallis. Philomath withdraws water from the Marys River. USGS flow data is reviewed in the hydrology section of this report. Water quality data from the six collection sites is reviewed below.

The mean values for several water quality parameters measured at sites on Rock Creek, Oliver Creek, Hammer Creek, and three sites on Muddy Creek, were examined to identify sites where current water quality standards have been exceeded in the past (EPA 1996). Rock Creek, sampled for dissolved oxygen, temperature and pH once during 1990-1994, was within standards for these parameters.

In one sampling event during 1990-1994, Muddy Creek near Corvallis had mean temperatures of 20.2 Celsius and high concentrations of total phosphorus. Muddy Creek at Finley Wildlife Refuge had low concentrations of dissolved oxygen during a single sampling event in this period. Additional water samples were collected at sites on Muddy Creek, Hammer Creek and Oliver Creek during the 1970s. The only standards exceeded in these data were for fecal coliform at all sites with a high mean of 1,013/100ml (standard is 200/100ml) on Hammer Creek at Alpine.

E&S Water Quality Report

For a report on water quality prepared by E&S Environmental for the Cascade Pacific Resources Conservation and Development (RC&D), surface water samples were collected at 10 sites on Beaver Creek, Oliver Creek, and Muddy Creek during two storm events in the winter of 1996. Concentrations of suspended solids and phosphorus were moderate to high for all the sampled sites although not to the high levels as measured in some other streams in the Willamette Valley. Concentrations were lowest higher in the watershed and increased as channels cut through alluvial surfaces in the agriculturally dominated lowlands. The Muddy Creek mainstem was characterized as a low gradient depositional system with fairly good water quality. Reese Creek was characterized as having the highest erosion rates and concentrations of suspended solids and phosphorus.

Benthic macroinvertebrate samples were also collected and sites rated by assessing species presence and abundance. All of the sample sites were dominated by "tolerant taxa" indicating that stresses associated with poor water quality are likely impacting aquatic species throughout the Benton Foothills analysis area. Gleason Creek had the highest assessment, while the Muddy Creek mainstem was the poorest. Once again, Reese Creek had the poorest rating among the mainstem tributaries.

Summary of Available Data

Current data implies that water quality in the Muddy Creek watershed is, with some notable exceptions, generally acceptable but likely to be at risk and probably degraded from reference condition. Some of the weaknesses in the current data include:

1) little or no data available for summer base flow when conditions are most likely to be limiting,
2) data for forested uplands appears to be unavailable,
3) follow up data establishing trends for parameters of concern is unavailable, and
4) major data gaps exist for parameters of concern to fisheries and aquatic species (i.e., stream temperature and dissolved oxygen concentrations during baseflow).

These are major gaps in our knowledge; this indicates that current assessments of conditions are strictly preliminary. The little data that is available implies that water quality conditions for aquatic species are probably degraded in much of the Muddy Creek mainstem and its perennial tributaries, particularly during the summer when a combination of reduced base flow and heavy use and withdrawal of available water coincide (see Water Rights in the Hydrology section). *Hypothetically,* deteriorated channel conditions in tributary streams would also be expected to contribute to degraded water quality and aquatic habitat in this watershed (see Channel Conditions section).

Water Quality Parameters of Concern

Sediment and Turbidity

Sediment production, delivery to streams, and transport through streams is poorly quantified in general, and the Muddy Creek watershed is no exception. Sediment processes are understood in a generic sense, but site specific data are rarely available, particularly for forested uplands. Although some sites of sediment delivery to upland streams from landslides and roads were identified in this report (see Soils section) no measurements of quantities of sediment delivered or transported, scoured and deposited, or the infiltration of gravels by fine materials (sands, silts, and clays) on forested streams managed by the BLM are available for this analysis.

Sampling by E&S Environmental indicated that total suspended solids were "moderately high" in the Oliver and Beaver Creek drainages but remained stable in the Muddy Creek main channel during storm events in the winter of 1996 (E&S Environmental 1996). Reese Creek was identified as a sub-basin with high levels of erosion and suspended sediment. The report concluded that Muddy Creek, as would be expected, is a depositional site and responds differently to storm runoff events from its tributary streams. While the report indicated that suspended solids in tributaries were high and suggested that "reduction of erosion in the tributary streams" would improve water quality, no indication of the sources of this eroded material or to what extent its origin was anthropogenic was made.

This analysis identifies some of these sources and evaluates their potential for degradation of water quality and aquatic resources. In this watershed, the most likely sources of stream sediment include:

1) stream bank and channel erosion,
2) surface erosion off agricultural lands, and
3) erosion from upland forested lands.

For this analysis, a qualitative inventory to evaluate potential for stream bank erosion in lowland and upland channels and an evaluation of potential sediment sources from forested upland sites was conducted.

Bank Erosion Assessment

One major source of suspended solids in tributary streams is likely to be bank erosion in streams that have incised in the alluvium at the base of the forested uplands. Many of these channels were altered as a result of land management practices earlier in the century (primarily through cattle grazing and drainage structures for the establishment of agricultural crops) and have yet to stabilize (see Channel Condition section).

To assess bank erosion potential, an informal survey was conducted in the Oliver Creek sub-basin (BLM 1996). Eleven sites where the channel was accessible from the road were evaluated employing criteria developed by Dave Rosgen (Rosgen 1996). Conclusions from this assessment include:

1) Channels in the forested uplands have low potential for bank erosion, primarily because the majority of these channels have no stream banks,

2) Moderate bank erosion potential exists in response type channels in the forested uplands and sections of active bank erosion in these stream types was observed. The BLM manages very little of this stream type in the Benton Foothills,

3) Transition channels from the forested uplands to the Muddy Creek mainstem have moderate

to high bank erosion potential. Many of these channels are deeply incised in alluvial material and severe, active bank erosion was observed at several sites,

4) Transition channels are partially protected by deeply rooted riparian vegetation and the resistant nature of the fine particle soils composing their banks. This has resulted in greater channel down cutting rather than widening and probably limits active bank failure to large storm events, and

5) The Muddy Creek mainstem has high bank erosion potential but is currently stable due to maintenance of the riparian vegetation and low stream energy.

Forest Management in the Muddy Creek Watershed and Stream Sedimentation

Based on research results from other forests (Grant 1991), it is generally true that past and current forest management activities have triggered hillslope failures near roads and clearcuts with delivery of sediment to streams in excess of that under reference condition. However, in this watershed, these processes are limited to small areas and are most likely unimportant as major sources of sediment delivery to streams (see Soils section). The most likely active sources of sediment and organic material in the forested uplands portion of this watershed include:

1) fine sediments from road and trail surfaces,
2) surface ravel erosion from steep hillslopes immediately adjacent to channels, and
3) channel incision into soils on terrain subject to deep seated slump-earthflow.

Of these three processes, road and trail surface erosion has the greatest potential for degradation of water quality with impacts to aquatic resources as it tends to be chronic, and there was no analogous erosional process under reference conditions.

Forest Roads and Stream Sedimentation

Some potential sources of accelerated sediment delivery to streams were identified during the BLM's summer 1996 road inventory. Recommendations for treatment of these sources are listed under restoration opportunities. In addition, road segments on BLM lands will be evaluated for risk to water quality as one factor under the transportation management plan objectives to be completed during subsequent analysis iterations. Of the several sources of accelerated erosion in the forested uplands in this watershed, high use mainline haul roads adjacent to streams are likely to be the single largest contributor of fine sediment to streams. These roads are a high priority for closure however, due to right-of-way agreements and the need for access, few of these roads will be closed (see Transportation section).

Off-Highway Recreational Vehicle Traffic and Stream Sedimentation

An extensive recreational vehicle trail system is concentrated on the slopes of Flat Mountain in the Beaver and Reese Creek sub-basins (Map 13). Although the main trail system was mapped by the Flat Mountain Riders Association and use is subject to permit (administered by Starker Forests, Inc.), much of the trail system on public lands is essentially unregulated and unmapped. There is a high potential for water quality degradation as a result of heavy trail use during the winter.

In the fall of 1996, the BLM conducted a preliminary survey to ascertain trail conditions on public lands. The main conclusions of this survey were:

> 1) Most of the trail system is concentrated on private lands, and these areas appear to receive the heaviest use,
>
> 2) the actual trail system is far more extensive than that displayed on the Flat Mountain Riders Association map,
>
> 3) conditions on the main mapped trails on public lands are generally good, and very few sites where trails are actively degrading water quality were observed, and
>
> 4) there was evidence of trail maintenance and attempts to control drainage and/or reduce water quality problems, but these frequently are not fully effective.

A more intensive inventory is being proposed for mapping the entire trail system on public lands and evaluate trail conditions at stream crossings.

Turbidity Sampling

Turbidity samples were collected during March 1997 at two sites on Beaver Creek: a lower site at the bridge crossing Beaver Creek on Bellfountain Road and an upper watershed site on a third order tributary to Beaver Creek that drains headwaters primarily managed by the BLM (Cheyenne Creek, T.13S., R.6W., Sections 17 and 19). This data is displayed in Figure 6.

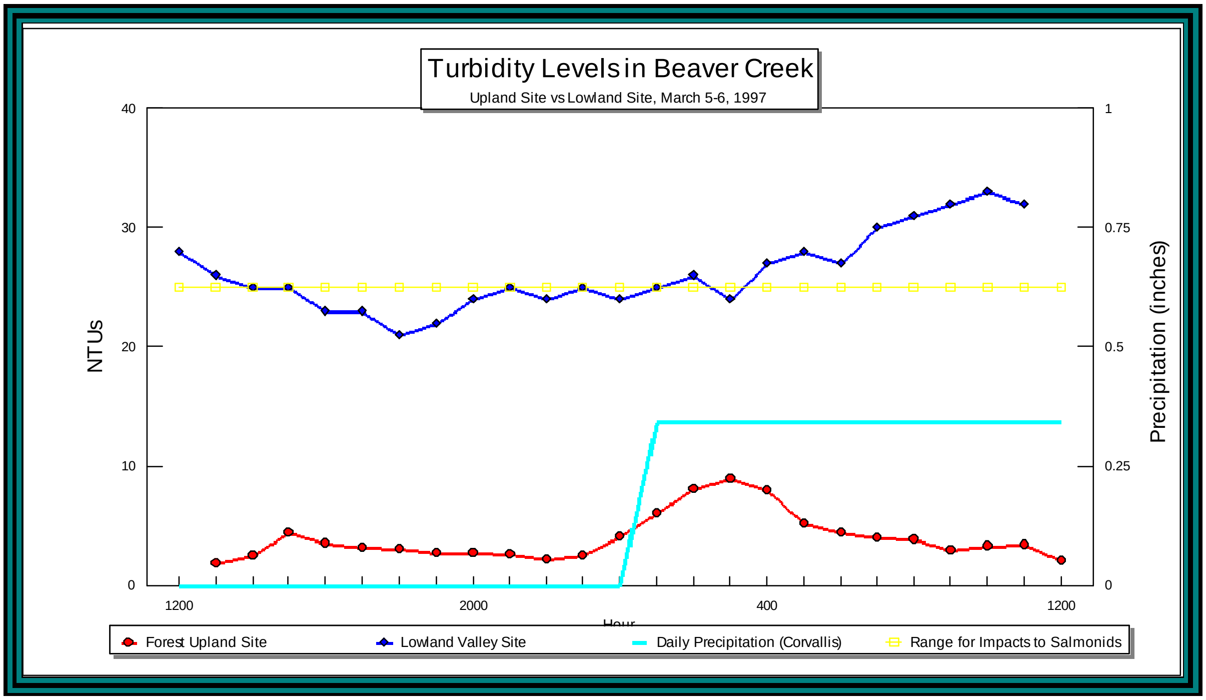


Figure 6. Turbidity Levels in Beaver Creek

These samples demonstrate the relationship of turbidity in forested uplands relative to lower agricultural areas generally observed on streams in the Benton Foothills. The Nephalametric Turbidity Units (NTU) levels at the forested site are within the range that has been measured at other forested sites in the Marys Peak Resource Area during winter base flow. The NTU levels at the lower site are an order of higher magnitude representing both the higher stream energy expected in a larger channel and the high concentrations of suspended sediment observed at this site. These levels of turbidity, if sustained over long periods during winter base flow, are high enough to impede anadromous fish survival. The consequences of high turbidity and the condition of other water quality parameters for the aquatic environment is discussed in the fisheries section of this analysis.

Stream Temperatures and Dissolved Oxygen

Solar radiation is a principal factor controlling stream temperatures. Solar energy inputs to streams is affected by the quality and quantity of shade-producing vegetation, topography, season, flow, and channel form. Natural disturbance agents such as fire, windthrow, and storm-induced channel scour, and human activities such as timber harvest, road construction, and riparian-based recreation have the potential to influence stream temperature by altering stream side vegetation, summer base flow regime and channel form. Small, headwater streams are particularly at risk for increases in stream temperature as a disturbance result. Dissolved oxygen concentration is linked to stream temperature and together these parameters are critical to the reproduction and survival of anadromous fish.

Sources for stream temperature increases due to inadequate cover from adjacent riparian vegetation (i.e., potential "hot spots") are identified in the riparian vegetation section of this analysis. Stream temperatures may be monitored at those sites on BLM land to further evaluate and document conditions.

Continuous stream temperature data was located for only a single upland site in this analysis. Figure 7 displays summer stream temperatures (seven-day average maximum) collected by the BLM on the headwaters of Hammer Creek prior to harvest. This area was thinned in the fall of 1996 and follow up data will be collected in the summer of 1997. The 1993 data indicate that this high gradient tributary stream is fairly cool at base flow and, under full forest cover, temperatures are adequate to support aquatic life and cold water species in this analysis area. Temperatures appear to be well within the "Historic Range" expected for tributaries of the Willamette River (USDA 1993). Under the Northwest Forest Plan, harvesting activities are expected to have no measurable affect on stream temperatures. Monitoring of stream temperatures at this site in 1997 will help to verify this hypothesis.

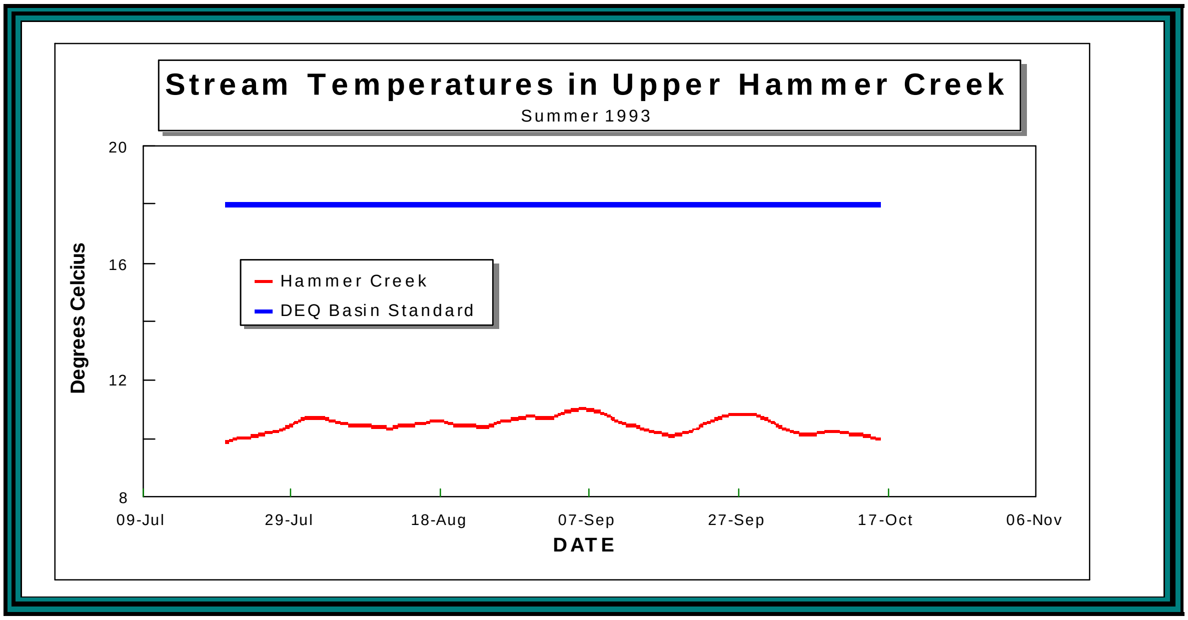


Figure 7. Stream Temperatures on Hammer Creek Tributary, Summer 1993

Recent dissolved oxygen data, particularly for upland forested sites, were not located for this analysis. Where stream temperatures exceed state standards it is likely that levels of dissolved oxygen will be depressed, further stressing aquatic communities. In addition, heavy concentrations of organic materials such as logging debris and hardwood leaf droppings in the fall may cause local, short-term reductions in dissolved oxygen which can be lethal to salmonids. However, under current forest practice regulations, these conditions are unlikely to persist.

The areas with the highest potential for high stream temperature and low dissolved oxygen levels are in the mainstem of Muddy Creek and the lower gradient portions of its tributaries. Poor stream temperature and dissolved oxygen conditions were documented, albeit with only one sample, in portions of lower Muddy Creek in the 1970s. Recent data documenting conditions in these streams was not located for this analysis.

Microbiology

Concern over the potential for introduction of pathogenic micro-organisms to surface waters has risen in recent years, due in part to the increased human use associated with unmanaged, dispersed recreation occurring in riparian areas adjacent to urban zones as well as to livestock grazing in lower river valley reaches. In addition, forest management activities may be perceived as threatening to rural users of surface waters as a source of domestic water supply. This situation is particularly common at the urban-forest boundaries in the Willamette Valley foothills.

Forest management, in and of itself, is not thought to influence the levels of pathogenic bacteria in streams. High levels of bacteria in forested areas will usually be associated with inadequate waste disposal by recreational users, presence of animals in the riparian zone, and septic systems (EPA 1991). Dispersed camping and recreation occurs along stream banks in portions of the analysis area and may result in unsanitary disposal of human fecal matter in the riparian zone. Bacterial contamination of streams may result from elk and other wild animals including beaver and deer. In addition, incidences of giardia, cryptosporidium, and *E. coli* contamination of surface and spring water have been reported in many Oregon streams (O' Shea 1995, personal communication).

The existence or extent of water-borne disease contamination in surface waters of the forested uplands in the Muddy Creek watershed appears to be unknown; the BLM has not sampled for fecal coliform, giardia or other water-borne disease organisms. Nevertheless, giardia is considered an endemic species and is commonly found in beaver and even domestic dogs throughout the state. All surface waters utilized for domestic purposes should be disinfected and filtered. Domestic water users may have their drinking water quality tested for a nominal fee by the Microbiology Department at Oregon State University in Corvallis.

As stated earlier in this report, concentrations above state water quality standards for fecal coliform bacteria were measured in surface water samples from lowland portions of the watershed: Hammer Creek at Alpine, Oliver Creek at Bellfountain, and sites along the Muddy Creek mainstem in the 1970s. These disease organisms are unlikely to be associated with forest management activities in the headwaters of these streams. No follow up monitoring or data was located for this analysis, and current conditions at these sites is not documented in this report.

Other Water Quality Parameters

A brief discussion of additional water quality parameters which are potentially influenced by forest management and for which limited data was located, follows.

pH - All samples were within the range (6.0- 8.0) set by the DEQ as necessary to protect aquatic life. No sampling has been conducted on public lands.

Conductance - No standards have been established. Sample values are at the low end of natural variability. This is expected in streams of the Pacific Northwest.

Nitrogen and Phosphorous - Values appear to be in the ranges expected of freshwater streams. Phosphorous is somewhat higher than the 0.10 mg/L state standard but not as high as many streams in the Willamette Basin. Forest management influence on these nutrients is primarily through the introduction of fine sediment which provide surfaces for these nutrients to adhere to.

Herbicides and Pesticides - Water quality data for organic chemicals was not reviewed for this analysis. Organic chemicals are not currently used on BLM lands but are known to be extensively applied on adjacent private forest lands and in lowland agricultural areas.

Confidence in the Analysis

Despite the relative “data richness” of this watershed relative to other watersheds BLM manages, it is not possible to state with confidence whether or not water quality in the Muddy Creek watershed consistently exceeds or meets state water quality standards or if water quality is a factor in the degradation of aquatic ecosystems. Although invertebrate samples appear to indicate generally poor water quality, there has not been enough sampling to identify trends or to separate out what can be attributed to human influence from natural communities that occur in depositional environments. In particular, we lack data to support conclusions with regard to stream temperature, dissolved oxygen, and sediment; all critical factors for the aquatic community in this watershed that have potentially been altered by land management. Conclusions are mostly hypothetical and are based on professional estimate, deduction, and extrapolation. Overall, the material in this section is adequate for broad planning purposes, particularly for suggesting water quality monitoring activities. Site specific data and recommendations are necessary to apply conclusions from this section to specific projects.

Fish Species and Habitats

A. Reference Conditions

Pre- and Post-Euro-American Settlement

Little information is known about specific habitat conditions and fish populations during pre-Euro- or post-Euro-American settlement. It is believed that fish population, distribution, and habitat condition were in an upward trend or stable compared to the current conditions. However, events and activities (natural and man caused) which may have affected fisheries in the Benton Foothills analysis area are presented.

Historically, a variety of natural processes such as fire, floods, landslides and wind storms, played a significant part in fish habitat condition and fish populations. These processes may have resulted in significant impacts for the fishery resources. It is also believed that many human activities such as home sites, pastures, splash dams and other early logging methods (jack screws and horses, oxen and mules, sawmills, steam donkeys, tractors, railroad logging and road building) played a significant part in affecting fish habitat condition and fish populations. Some stream reaches or entire subwatersheds may not be properly functioning in a reference condition for seasons or decades due to disturbances. It is also assumed that fish populations may have fluctuated due to these events. However, at the watershed scale the reference condition would have been dominated by functional habitat.

Fire, Floods, Landslides and Windstorms

Historically, portions of the watershed have repeatedly burned. It is likely that large woody debris was common in streams before and after these fires. It is also likely that large woody debris increased in streams following fire and therefore, large woody debris was probable more persistent in the burned areas of the watershed. Fires in the watershed may have caused problems such as excessive sediment input, elevated water temperatures, lack of good aquatic habitats for macro-invertebrates and removal of large riparian areas.

Prior to the 1964 flood of the Oregon Coast Range, there were probably other major floods that influenced fish habitat and fish populations in the analysis area. These floods may have prematurely washed fish eggs/young of the year from suitable habitats and removed much of the large woody debris. Landslides and windstorms probably introduced large amounts of wood and sediment. The quantity is unknown, and probably short-lived during the late 1800s because of splash dams and channel clearing.

The natural processes (fire, floods, landslides, and wind storms) may have contributed to log jams that prohibited fish migration, sediment inputs that reduced the probability of egg survival, and high streams flow that would prevent spawning from taking place during the spawning season. However, the same natural processes resulted in abundant log jams which provided instream cover and dissipated flow. Large woody material probably trapped spawning gravel and created rearing pools, particularly in the lower gradient (>2% gradient) sections of the analysis area.

Human Activities

Prior to the settlement of the Willamette Valley (in the mid-Nineteenth Century), Native Americans harvested resident fish as a food source as well as for other traditional or ceremonial uses. Perhaps the fish population and fish habitat were influenced, however, specific knowledge about species presence, fish populations or habitat conditions prior to settlement is unknown.

The first settlers appear to have moved into the Benton Foothills analysis area in 1840s. Fish habitat in this analysis area has been altered substantially since EuroAmerican settlers first arrived in the mid 1800s.

Some of the major activities which could have occurred and changes which they could have created are mentioned below.

Much of the valley bottom land and areas along the lower mainstem and the lower portions of the large tributaries have been cleared for pastures and home sites. These activities have substantially reduced the amount of active flood plain and have eliminated many of the productive flats, side channels, and seasonal refuge areas within the lower basin of the analysis area. Changing the stream channel morphology and removing stream bank vegetation has increased channel scour, reduced bank stability, and increased sedimentation in these same areas. The number of large conifers that have the potential to fall into streams has been substantially reduced along most streams adjacent to developed pasture lands.

A number of areas were initially cleared and developed as homesteads in the mid-1800s and early 1900s. While concentrated in flat valley bottom areas, these sites were distributed throughout the valley and often extended into the headwaters and tributary streams. The initial clearing eliminated almost all of the large conifers which had potential to fall into streams as LWD.

Splash Dams

During the 1800s, at least one splash dam was operating on the Upper Marys River (Moser and Farnell 1981; Sedell and Luchessa 1982). Splash dams were constructed to transport logs downstream during all flows. It is not known if splash dams were built anywhere in the Benton Foothills analysis area. It is not known how much usage the Marys River splash dam(s) received during it’s operation nor for how many years this activity took place. It is believed that splash damming, in general, occurred for a period of approximately 27 years from 1880-1910.

Splash dam operations may have caused extensive channel simplification and degradation of fish habitat through the disruption of riparian vegetation and the removal of gravels structure in Marys River. Substantial changes may have occurred during splash damming activities such as stream widening, stream banks scouring, and the removal of trees, logs and boulders in order to prevent log jams during the drives (Sedell and Luchessa 1982). It is thought that splash dams may have had a greater impact on streams than floods because splash dams were repeated time after time during the year and instream structure was removed.

Timber Harvest

Other activities which influenced fish habitat and fish populations in the late 1800s were timber harvest and the use of sawmills on nearby homesteads. Early logging methods may have caused large amounts of sediment to move into streams and the removal of instream structure. These affects would have limited fish habitat and population. Effects from sawmills built in the 1850s are unknown.

B. Current Conditions

Anadromous Fish Species

According to available data, anadromous fish species are not present in the Benton Foothills analysis area. Anadromous Fish are known to exist in the Willamette River but not in the Muddy Creek drainage. Chinook salmon (*Onchorhynchus tshawytacha*) and steelhead (*O. mykiss*) are the principal anadromous species of the Willamette River into which streams in this analysis area indirectly flows. The introduction of coho and steelhead are not known. However, coho salmon were re-introduced into the westside Willamette Basin drainage in the 1950s and 1960s, but runs have basically failed. Winter steelhead have also been re-introduced to all suitable major drainages and populations seem to be increasing. Pacific lamprey are found in Muddy Creek.

Historically, the Willamette Basin was severely limited for fish habitat and species by numerous natural and manmade factors. Pollution problems were contributed from sawmills, cannery wastes, raw sewage, and sulphite pulp liquor in the lower Willamette River, and the Willamette Falls at Oregon City which blocked anadromous passage during low flow conditions. A rigorous pollution abatement program was started in early 50s, and construction of the Willamette Falls Fishway was completed in late 60s. Reduction of these pollution problems helped, but salmonids still face low summer and fall flows, numerous irrigation diversions, low dissolved oxygen levels, and impassable falls and dams (BLM data records).

Endangered or Threatened Fish Species

The Oregon chub (*Oregonichthys crameri*) is a small minnow whose historic and native distribution is limited to the Willamette River basin of Oregon. The Oregon chub likely evolved in the absence of abundant predators. The uniqueness of the Oregon chub and its apparent population declines were initially detected in the 1970s. On April 10, 1990 Oregon chub was petitioned to be listed as an endangered species and to designate as critical habitat all waters and tributaries to the Middle Fork of the Willamette River, from the base of the Dexter Dam upstream to its confluence with the North Fork of the Middle Fork. The Oregon chub was federally listed as endangered in 1993. The re-introduction of Oregon chub into historical suitable habitat is necessary to establish new populations and thereby promote recovery to the species.

In 1993, the only known remaining and stable Oregon chub populations were restricted to an 18.6 mile (30 kilometer) section along the Middle Fork of the Willamette River, in Gray Creek, on Finley National Wildlife Refuge (NWR), and near Greens Bridge on the North Santiam River. Because existing Oregon chub populations are small, isolated, and have limited natural dispersal potential within the Willamette River basin, the species is vulnerable to extinction. (ODFW, Annual Progress Reports 1996, Oregon Chub Investigations). These populations represented only two percent of the species historic range. Although several additional populations have since been documented, the remaining populations occur primarily near rail, highway, and power transmission corridors and within public park and campground facilities. Most of these populations are at risk from chemical poisoning, competition for resources with and predation by non-indigenous fishes and amphibians, and siltation of shallow water habitats due to logging activities and water flow manipulation.

Resident and Introduced Fish Species

Current Relative Abundance and Distribution- It is difficult to obtain a representative sample or an accurate estimate of the population for fish within the BLM managed lands. It is believed that resident fish such as trout reside in most of the streams throughout the analysis area. There is no existing data pertaining to populations of these resident fish. It is believed that many second order and all third order streams on public lands with gradient less that 8% have fish. It is also known that some first order streams have fish in the lowlands of the analysis area. Most of these first order streams are located in Lower Muddy and Upper Muddy sub-basins.

There are 22 introduced species of fish in the Muddy Creek Drainage. Many of these species are in the Centrarchidae (sunfishes and black basses), Percidae (perches, walleyes), Salmonidae (salmon, trout, whitefish), and Cyprinidae (minnows and carps) families (Appendix 6).

Aquatic Habitat Condition

Most stream reaches in forested areas of the Pacific Northwest encompass a variety of channel features that include different types of riffles and pools. Each of these features provides different habitat values for different fish species at various life history stages. The identification and measurement of habitat units have become important for quantifying fish habitat and identifying limiting factors for fish population (e.g, Bisson et al. 1982; Hankin and Reeves 1988).

Aquatic habitat is characterized based on the following elements that are critical to at least one life-stage of most aquatic species (Table 6).

C Condition of streambed substrates
C Abundance of large woody debris in stream channels
C Area and quality of pools at summer flows

Large woody debris, substrate, pools, and off-channel habitat interact with disturbances and the valley form to create aquatic habitats. Properly functioning habitat sustains a diverse community of aquatic and riparian species. In contrast, habitat that is not functioning properly lacks adequate habitat elements or processes to sustain aquatic plants or animals at one or more life stages (Table 9). Some stream reaches or entire subwatersheds may not be functioning properly in a reference condition due to disturbances such as wildfire or debris torrents. However, in the analysis area the reference condition would be dominated by functional habitat as described in Table 6.

Riffle substrates in deposition and depositional flat reaches in a reference condition are dominated by gravels and cobbles with small amounts of fine sediments, sands and silts. This provides a properly functioning condition for fish spawning and egg development, food production, and sub-surface discharge. Deep pools with abundant woody debris create complex rearing habitat critical for fisheries. Large woody debris and beaver dams create slow water habitats, side-channel, and off-channel habitat critical for winter fish rearing.

Tables 7 and 8 display the habitat survey summary and the habitat ratings resulting from the criteria listed in Table 6.

TABLE 6: ASSUMED REFERENCE CONDITIONS FOR SELECTED LIFE-STAGE HABITATS OR INDICATORS OF SALMON AND TROUT

(based on NFP 1994, NMFS 1995, Washington Forest Practices Board 1993, DEQ 1996, and PAC Fish)

Stream Habitat Factors	Properly Functioning	At Risk	Not Properly Functioning
Stream substrate	Dominant substrates are gravel and cobble with very little fine sediments.	Gravel and cobble are subdominant substrates or embedded with moderate amounts of fine sediment.	Sand, silt or bed rock substrates are dominant or most gravel and cobble substrates embedded with fine sediments.
Stream temperature	7-day average of daily maximum temperatures does not exceed 15.5EC.	7-day average of daily maximum temperatures between 15.5 and 17.8 EC.	7-day average of daily maximum temperatures exceeds 17.8EC.

Percent of stream area in pools: Depositional flat reaches Deposition reaches Transport/source reaches	>55% >40% >30%	40-55% 30-40% 20-30%	<40% <30% <20%
Percent of pool number that are complex *	>20%	10-20%	<10%
Winter rearing habitat	Abundant beaver dams, damned pools, or off-channel habitats.		Habitat types are infrequent.
Large Woody Debris pieces per miles **	>80	30-80	<30

* Complex pools are >3 feet deep (streams >10 feet wide) or 1.5 feet deep (streams < 10 feet wide) and have high woody debris cover (greater than 60% cover from wood plus 3 pieces of woody debris or ODFW wood rating greater than 4).

** Woody debris is greater than 24 inches in diameter and 50 feet long.

Table 7: Stream Conditions on BLM Managed Lands That Were Surveyed Using the ODFW Methodology*

Sub-basin Name	Dominant Substrate	% Com-plex Pools	LWD Pieces per Miles	Pool Area Percent	Total Reach Area Meter Sq.	Total Length
Beaver Creek	gravel cobble	1%	27 pieces	10.2%	7,847 (m2)	2.9 miles
Hammer Cr.	no data	no data	no data	no data	no data	no data
Lower Muddy Cr.	no data	no data	no data	no data	no data	no data
Moss Creek	no data	no data	no data	no data	no data	no data
Oliver Creek	gravel cobble	2%	39 key pieces total	12.4 %	16,523 (m2)	4.3 miles

Reese Creek	silt, organic and sand	0%	11 pieces	.5%	2,626 (m2)	1.2 miles
Upper Greasy Cr.	gravel cobble	0%	13 pieces	13.3 %	1,728 (m2)	1.1 miles
Upper Muddy Cr.	no data	no data	no data	no data	no data	no data

* All of the stream reaches surveyed were in the transport/source reaches.

TABLE 8: AQUATIC HABITAT RATINGS FOR BLM REACHES WITHIN THE SUBWATERSHEDS (SEE TABLE 6)

Sub-basin Name	Temp	Barriers	Substrate	LWD	Pool Area	Pool Quality	Off Channel	Channel Condition
Beaver Creek	?	PF	PF	N	N	N	R	R
Hammer Creek	?	?	?	?	?	?	?	?
Moss Creek	?	?	?	?	?	?	?	?
Oliver Creek	?	PF	PF	N	N	N	R	R
Reese Creek	?	PF	N	N	N	N	R	N
Upper Greasy	?	PF	PF	N	N	N	R	R
Upper Muddy	?	?	?	?	?	?	?	?

Habitat Ratings: Properly Functioning (PF); At Risk (R); Not Properly functioning (N); Unknown (?)

TABLE 9: HABITAT REQUIREMENTS FOR KEY LIFE STAGES OF FISH SPECIES

(Habitat information based on ODFW (1995), Nickelson et al., (1992), Trotter (1989), and Wydoski and Whitney (1979)).

Species	Spawning or Breeding Habitat	Spring Rearing Habitat	Summer Rearing Habitat	Winter Rearing Habitat
Oregon chub	Very little current, feed in the water column, and spawn in aquatic vegetation, slackwater habitat	Larvae generally congregated in near shore areas, in the upper layers of the water column, in shallow water	Backwaters, off-channel habitat, alcoves and isolated ponds, slough	Backwaters, off-channel habitat, alcoves and ponds

Oregon coast cutthroat trout	Abundant clean gravels in 2-3 order deposition and transport reaches (sometimes in lower source reaches)	Stream margins and backwater areas	Pools with woody cover: cool stream temperatures. May migrate downstream to mainstem habitats	Beaver ponds, dam pools, and off-channel quiet water habitats with complex woody cover. Migrate to winter refuge areas during fall freshets
Pacific lamprey	Clean gravel in 2-5 order deposition and depositional flat reaches	Backwater sand and silty areas for up to 6 years	Backwater sand and silty areas for up to 6 years	Backwater sand and silty areas for up to 6 years
Sculpin	Cobbles and boulders or large wood in 2-5 order streams in all reach types less than 20% gradient.	Stream bottom substrates in pools and riffles	Gravel to boulder substrates in pools and riffles	Gravel to boulder substrates in pools and riffles

Sediment and Turbidity Effects on Fish and their Habitats

(see Water Quality section for potential sources and location)

In general, an increased sediment load is often the most adverse effect of forest management activities on streams. Large increases in the amount of sediment delivered to the stream channel can greatly impair or even eliminate fish and aquatic invertebrate habitat, and alter the structure and width of the streambanks and adjacent riparian zone. The amount of sediment can affect channel shape, sinuosity and the relative balance between pools and riffles. Changes in the sediment load also will affect the bed material size which in turn can alter both the quantity and the quality of the habitat for fish and benthic invertebrates.

Numerous studies have documented the adverse impacts of fine sediment on benthic invertebrates as well as salmonid reproduction and growth (Chapman and Mcleod 1987). Hynes (1970) characterizes streams with sandy beds as having the lowest species diversity and aquatic productivity. Fine sediments tend to fill the interstices between coarser particles which reduces the habitat space for small fish, invertebrates, and other organisms.

Reduced gravel permeability can inhibit salmonid reproduction by reducing the concentration of DO and by entrapping alevins or fry. Different species have varying sensitivity to sediment at different life stages and under different environmental conditions. An excess of fine sediment can adversely affect habitat availability. Often, however, pool filling is due to sand-sized particles; these may not necessarily be transported as suspended sediment. Thus an increase in the concentration of suspended sediment may not necessarily be correlated with a decreasing bed material particle size. Direct effects of suspended sediment on salmonids, and likely trout, occur only at relatively high concentrations.

Most of the biological effects of turbidity are due to the reduced penetration of light in turbid waters. Less light penetration decreases primary productivity, with periphyton and attached algae being most severely affected. Declines in primary productivity can adversely affect the productivity of higher trophic levels (Gregory et al., 1987). The type and amount of bedload is very important in determining the amount of microhabitat available for juvenile fish and macroinvertebrates. (see Water Quality section).

Current Condition and Distribution of Habitat for BLM and Other Managed Lands

<u>Current Habitat Managed by BLM</u> - Habitat inventories indicate that Oregon chub do not and would not inhabit higher elevations of the analysis area (transport/source reaches). The aquatic habitat rating in Table 8 describes sub-basins within BLM-managed lands, and Map 14 displays fish distribution.

<u>Upper Muddy sub-basin</u> -The potential for fish presence is low due to stream locations and gradients. The off-channel habitats used by the Oregon chub have been greatly altered. Many of

the meanders, oxbows, sloughs and side channels have been eliminated by channelization, diking, draining and filling. Large reservoirs have changed downstream hydrologic character-istics (i.e., flood frequency, stream flows and water temperatures) and various sources of pollution have reduced water quality. The cumulative effects of these actions are greatest on low gradient and low elevation waterways characteristic of the Willamette River basin used by Oregon chub.

The Oregon chub population in Gray Creek contains many age classes and is not threatened by exotic predatory fishes. The habitat conditions are silted and shallow with slow water velocity. There is considerable vegetation, and populations are often associated with beaver pond activity. Land management practices such as farming and logging adjacent to Gray Creek and above it could threaten the habitat and water quality with sedimentation and chemical runoff. (P. D. Scheerer, C. R. Shafer, C. H. Stein and K. K. Jones, Annual Progress Report, Oregon Chub Investigations, ODFW, April 1992).

Wildlife

A. Reference Conditions

Habitat

Prior to settlement, habitat within the Oregon Coast Range was managed primarily by fire, the main influence in shaping wildlife habitat within the Benton Foothills analysis area. Until the 1850s, Native Americans managed vegetation and game habitat by annually burning the Willamette Valley foothills, creating a savannah oak, maple, and Douglas-fir habitat type. Lands not directly influenced by fire on an annual/regular basis probably remained in a late seral-forest condition. Estimates prior to 1840 indicate approximately 20-40% of this analysis area was in a late-seral condition at the turn of the century (see Vegetation section).

Large fires typically left large amounts of partially burned fuels, resulting in standing snags and down coarse woody debris. As forests regenerated after fires, old growth remnants, standing snags, and down woody debris provided habitat for older forest species.

Special habitats such as caves, cliffs, talus, meadows, and wetlands are usually the results of local geomorphic features, and because of their small size can often be impacted by typical forest management practices. Special habitats that occurred in the analysis area during reference conditions are assumed to be present today in a comparable condition.

Unlike most of the interior watersheds in the coast range, the Benton Foothills analysis area saw a decrease in large fires with settlement. As a result, forest landscapes along the valley edge began to change from an oak savannah habitat type into a Douglas-fir dominated landscape.

Species

Species requiring early seral habitat, natural openings, grassland/savannah were probably more common under reference conditions. Species requiring large stands of contiguous late-seral habitat were also probably more common in the analysis area prior to the 1850s.

Species diversity within the Benton Foothills analysis area probably did not change significantly until the 1850s when the watershed became settled and the valley edges were no longer burned on an annual basis. Similar to interior watersheds, the Benton Foothills began to increase the amount of younger aged Douglas-fir plantations. Species that rely heavily on this habitat type are probably more common today than under reference conditions.

B. Current Conditions

Habitat

Current wildlife habitat within the watershed can be stratified into the following habitat types:

Total acres for the analysis area:	Analysis Acres	Area %	BLM Acres	%
Conifer Early-seral (stands 0-39 years of age)	18,144 acres	22%	1,758 acres	29%
Conifer Mid-seral (stands 40-79 years of age)	20,114 acres	25%	3,226 acres	53%
Conifer Late-seral (stands 80-199 years of age)	4,111 acres	5%	444 acres	7%
Conifer Old-growth (stands 200+ years of age)	20 acres	<1%	15 acres	<1%
Hardwoods (alder and maple dominated stands)	2,913 acres	4%	690 acres	11%
Non-forest (including agricultural lands)	28,269 acres	35%	11 acres	<1%
Special habitats	7,004 acres	9%	76 acres	1%

The analysis area currently contains less than 1% old growth and approximately 8% late-seral habitat. Under current guidelines, late-seral habitat within the analysis area is expected to decrease in the short term due to management objectives of Matrix lands. Late-successional habitat in the Riparian Reserves and Late-Successional Reserves in the long term. Watersheds directly to the west are expected to increase significantly in late-seral forests because of the late-successional reserve land use allocation.

Species requiring large contiguous blocks of late-seral habitat are probably less abundant than in reference conditions. However, the analysis area will continue to support local populations of late-seral species as riparian reserves move into this habitat type.

Unlike many coast range watersheds that have been recently logged, the Benton Foothills analysis area was heavily railroad logged and yarded in the 1930s and 40s. This type of logging left large amounts of downed “cull” logs and snags that are not present in many interior watersheds. As a result, most of the mid and young seral stands within the analysis area still contain an old-growth component.

The Benton Foothills analysis area is situated on the edge of the Willamette valley. Dispersal by highly mobile species is not expected to be significantly altered by any action within the watershed. Sufficient dispersal habitat from and into existing LSR is currently present in watersheds directly to the west of the Benton Foothills.

SPECIAL STATUS SPECIES

Only special status species, special attention species, and big game species will be addressed in this assessment. Special status species are those animals protected under the Endangered Species Act, and include federally listed as Threatened or Endangered, or federally proposed for listing as Threatened or Endangered species. Special Attention Species, as defined in the Final Supplemental Environmental Impact Statement on Management of Habitat for Late-Successional and Old-Growth Forest Related Species within the Range of the Northern Spotted Owl (USDA Forest Service and USDI BLM 1994) and the Record of Decision (USDA Forest Service and USDI BLM 1994) are species which may not be adequately protected by the Northwest Forest Plan. Species to be addressed in this analysis must be within the geographic range of the Benton Foothills analysis area and be potentially affected by actions that take place on BLM. The following conditions refer only to BLM-administered lands within the analysis area.

Special Status Species

Arthropods

Fenders Blue Butterfly (*Icaricaia icarioides fender*) Federal Candidate

The Fenders blue butterfly prefers natural bald (shallow soil types, usually on mountain ridges where grasses dominate) and meadows. There are no known sites for this insect, no surveys have been done, and no suitable habitat exists within the Benton Foothills analysis area.

Amphibians

Western Spotted Frog (*Rana pretiosa*) Federal Candidate

The Western Spotted Frog prefers aquatic and riparian habitat, but this species is believed to be extirpated from the Coast Range. There have been no sightings of this frog in western Oregon for over 20 years.

Birds

American Peregrine Falcon (*Falco peregrinus*)	Federal Endangered
Bald Eagle (*Haliaeetus leucophalus*)	Federal Threatened
Marbled Murrelet (*Brachyramphus marmoratus*)	Federal Threatened
Northern Spotted Owl (*Strix occidentalis*)	Federal Threatened

The American peregrine falcon breeds along the Oregon Coast, the Columbia Gorge, and the Cascade Range. There is no nesting habitat for the falcon in the Coast Range. No suitable habitat for this species exists within the analysis area, however falcons could use this area during the non- breeding season.

Bald eagles are most commonly found close to their preferred foraging habitat which in western Oregon includes the coast, large bodies of water and large rivers. There are no known foraging sites and no known nest sites for bald eagles within the Benton Foothills analysis area.

The majority of this analysis area lies within marbled murrelet zone 2, which lies farther than 25 miles from the coast. There are approximately 80 acres of suitable nesting habitat for marbled murrelets within the analysis area; none of these acres have been designated as critical habitat. Most of the suitable habitat within the Benton Foothills analysis area has been surveyed for the presence of marbled murrelets; no murrelets have been detected. It is assumed that marbled murrelets do not use the habitat within this analysis area.

There is one recognized northern spotted owl site within the analysis area. The site occurs on BLM land on the western edge of the analysis area boundary. The northern spotted owls that occupy this site have been successful at producing offspring in the past, but the habitat is less than optimal. The site is in a 60 year-old stand of trees on Matrix lands. A 100-acre core area has been reserved around this site.

Special Attention Species

<u>Mollusks</u>

Blue-gray Tail-Dropper (slug) (*Prophysaon coeruleum*)
Papillos Tail-Dropper (slug) (*Prophysaon dubium*)
Evening Fieldslug (*Deroceras hesperium*)
Oregon Megomphix Snail (*Megomphix hemphilli*)

These four mollusks may occur in damp areas in late-seral and old-growth forests within the analysis area. There are no known sites in the analysis area, no field surveys have been done, and survey protocols are not yet available.

<u>Mammals</u>

Fringed Myotis (*Myotis thysanodes*)

Long-Eared Myotis (*Myotis evotis*)
Long-Legged Myotis (*Myotis volans*)
Silver-Haired Myotis (*Lasionycteris noctivagans*)
Red Tree Vole (*Aborimus longicaudas*)

The fringed myotis require cave-like structures (mine shafts and abandoned buildings) for maternity roosts and hibernacle (winter roosts). This type of structure is not known to occur within the analysis area.

The long-legged myotis and silver haired bat may use cave-like structures for maternity roosts and hibernacle, but have also been found roosting under bark and in snags. This type of habitat can be found in the few existing late-seral and old-growth patches within the analysis area.

The red tree vole is expected to occur in its preferred habitat of late-seral and old-growth stands. Very few surveys have been done for this species; nests have been located at one site.

<u>Big Game Species</u>

Black Bear (*Ursus americanus*)
Black Tailed Deer (*Odocoileus hemionus columbianus*)
Cougar (*Felis concolor*)
Roosevelt Elk (*Cervis elaphus*)

Elk, deer, black bear, and cougar have populations that are either stable or increasing within the analysis area. For elk and deer populations, maintaining well-distributed foraging areas within the analysis area is needed. Black bear and cougar populations are expected to increase due to the recent ban on hunting these animals using bait and dogs.

Human Uses

A. Reference Conditions

Pre-EuroAmerican Settlement

Cultural evidence indicates that people inhabited Oregon's Willamette Valley at least as far back as 10,000 years ago. Within the Benton Foothills analysis area, nine archaeological sites have been identified (seven of them on USFW lands). Site artifacts consist of chipped stone tools, chipping debris and some ground stone artifacts. The majority of the sites occur on the flood plain below 300 feet elevation. Such sites are believed to represent camas and root harvesting activities. Two sites occur in hill or upland settings (both below 500 feet) and may have been locations for gathering other plant foods or campsites. None of these sites are dated but similar sites associated with camas gathering have been dated to 8000 years ago in the Long Tom drainage just to the south. In other parts of the Willamette Valley, these activities were carried out by the Native people (Kalapuya) until their reservation confinement.

The Chepenapho (Marys River) and Chemapho (Muddy Creek) bands of Kalapuya Indians inhabited this analysis area during its earliest recorded history. The Kalapuya were primarily a valley tribe, living along the Willamette River and its major tributaries. Since the Willamette Falls blocked most fish migrations into Willamette Valley streams, the Kalapuya did not have plentiful supplies of migrating salmon available. These bands may have seasonally crossed the Coast Range into the Alsea River basin to fish and trade with coastal tribes. The Kalapuya relied primarily on plant resources for food and products. The most important plants were camas and tarweed. They also hunted deer and waterfowl.

Post-EuroAmerican Settlement: Homesteading

The first homesteads in the analysis area were settled in the 1840s. In the 1850s, Congress, through various "homesteading laws," offered land to people who settled in Oregon. Many took advantage of the opportunity to get the free (or inexpensive) lands; as a result, the bottom lands of Muddy Creek and its tributaries were taken by the mid-1850s. Between 1854 and 1856, the government formed the Coast Indian Reservation and began moving the few remaining Kalapuya off the land and onto the reservation. Homestead claimants quickly filled the valley lands within the analysis area. The valley homesteaders were numerous and quite successful in their farming endeavors. Settlers then focused on obtaining land in the higher elevations of the Coast Range. Two rural schools were built, and land was used for pasture (sheep and cows) and crops (strawberries, grass and hay) until the 1920s-1940s (personal communication, Mr. D. Oakes, December 1996). Many relinquished their holdings after they were unable to make a living off those more marginal lands. Some upland homesteads remain identifiable by remnant fruit trees.

Transportation and Timber Harvest

The first major community in the area, Monroe, just east of the analysis area was founded in 1853. The community included a sawmill, built around 1850, a post office established in 1852, and a store. Road building also started around Monroe in the 1860s. Transportation into the area was by wagon road from Monroe and the Willamette Valley to individual homesteads. The Alsea to Corvallis Wagon Road (now Highway 34) passed to the north of the area. An 1853 survey map shows a trail running from just south of Dawson to Alsea. By the 1880s, the trail had been converted into a road. Other wagon roads slowly developed in the analysis area primarily for the purpose of farmers bringing their crops to Corvallis for marketing. In 1868, Inman's saw mill built in the North Fork Alsea watershed provided a local milling source for timber. Nearby, Ruble's mill ground wheat into flour. An 1884 survey map shows a road leading from Inman's Mill to the Dawson area. Other roads are recorded on maps in 1917, including a homesteader's road to Alpine (a school and community established some years before 1912) and to Bellfountain founded by 1895.

The U.S. government first started selling timber in the analysis area in 1918 to the Oregon Tie and Lumber Co. Numerous sales were made to the Corvallis Logging Company starting in the early 1920s. Corvallis Logging Company was an early corporate land owner of the analysis area's timbered lands. Other early logging companies that purchased government timber patents included Willamette Valley Lumber Co., W. J. Miller, I. P. Miller, Ralph Hull and Hull Lumber Company. Many of these companies were also early land owners in the area.

To access their own and government timber, a network of railroad lines and spurs were laid to extract the timber from the upland forests located on and around Oliver Creek, Green Peak and Flat Mountain. Beginning in the late 1930s, the rails were removed and the railbeds converted to roadbeds for log truck use. Many of the existing secondary roads within the analysis area are built upon the original railroad beds, often evidenced by gentle grades with long sweeping curves and deep throughcut excavations. Other lines simply had the rails removed before abandonment and are still traceable in the vegetation. Because tighter alignments are acceptable for rubber tired vehicles, the trestles were destroyed by demolition crews training for World War II service and short bypass routes contoured into and through drainages avoided the need for bridging.

Recreation

Euro-American recreational activities probably began in the 1850s when homesteaders moved into the Benton Foothills area. As the few primitive roads and trails were built into the forest lands, these new residents undoubtedly began to hunt, fish, and may have spent some of their limited leisure time exploring the backcountry. With the small population and limited access, use of the forested uplands was probably not very extensive until well after the turn of the century, and even then only by people oriented to forest-related recreational pursuits.

The quality of these early recreation pursuits would be considered high by today's standards. Wildlife and fish populations were abundant, the forest environment was relatively undeveloped and received few visitors. Users from that earlier era were self-reliant and did not require, or expect, the developed facilities available today.

The major factor contributing to higher levels of recreational use was the improvement of roads - State Highway 34, State Highway 99W, and the South Fork Alsea Access Road, along with the more primitive secondary roads. Recreation pursuits remained the same as in homesteading days, but with the ease of access, more people in the region were able to participate. The most dramatic change occurred when motorcycle trail riding became popular in the 1970s.

B. Current Conditions

Commodity Forest Products

The BLM manages 6,149 acres (8%) of the 80,647 acres in the Benton Foothills analysis area. The land use allocations (see Chapter 1) directly impact the amount and type of timber and special forest products that can be harvested while supporting goals set for other resource values. Management implications are as follows:

1) Late Successional Reserves are federal lands managed to protect and enhance late- successional and old-growth forest ecosystem conditions and to provide potential habitat for species dependent on these type of ecosystems (RMP 1995). Timber harvest or other management practices may be necessary to attain the conditions desired for Late-Successional Reserves and Riparian Reserves. There are approximately 503 acres of BLM land designated as LSR (official and unmapped spotted owl withdrawals) in this analysis area.

2) Matrix lands are managed to produce a sustainable supply of timber while also providing connectivity between LSR, a variety of habitat and ecological functions, and early successional habitat (RMP 1995). Traditional harvest and management practices may be necessary here to attain the conditions desired for this land use allocation. There are approximately 5,646 acres of BLM land designated as Matrix in this analysis area.

Late Successional Reserve (LSR)

Density Management Projects

Green Peak: The proposed project would combine varying levels of density management, including several 0.25 to 1 acre patch cuts, on approximately 102 acres near Green Peak. The project design is being created and driven by researchers at the Pacific Northwest Research Station in Corvallis, Oregon and the research branch of the U.S.Geological Survey. Green Peak is the only density management project planned for the analysis area at this time, and represents over half of the LSR in the analysis area. Potential for projects in the few remaining LSR acres is low. A 13 acre irregular stand (age 60) exists in the remaining LSR acres, but falls between two older stands providing a mosaic age pattern consistent with LSR objectives.

Matrix Lands

Timber Projects

The 5-Year Timber Sale Planning team analyzed the Marys Peak Resource Area for potential regeneration harvest opportunities. The team identified conifer stands 60 years or older, and grouped stands into parcels approximating the annual acreage commitment. The analysis identified four regeneration sales completely within the analysis area, and one sale partially inside the analysis area. Acreages are simple estimates at this time. The following shows planned regeneration harvest sales identified for the analysis area:

Sale Name	Fiscal Year	Estimated Acres	Estimated Volume (MMBF)

Reese Creek	1997	8	2.637
Botkin Road	1997	24	2.069
Finley Hill	2000	*	**
Green-Oliver	2002	*	**
Final Starr	2005	*	**

* approximately 70 aggregate acres
** approximately 6MMBF aggregate volume

In addition to this list of planned regeneration harvest sales within the analysis area, the Flat Beaver timber sale (93 acres, 5.032MMBF) was sold during 1995. For the period 1995-2004, 11.7MMBF of regeneration harvest timber sales have either been sold or are planned for sale on 193 acres within the analysis area.

Two commercial thinning harvests (Reese Creek, Super Hammer) have been sold for the period 1995-2004. The areas are approximately 274 acres in size and have a volume of 5.189 MMBF.

Using the following criteria, GIS analysis determined the acres potentially available for regeneration harvest on Matrix lands: 1)stand age = 70+ years; 2) contains conifer; and 3)outside Riparian Reserves. The analysis identified 408 acres which met these criteria. According to the RMP, regeneration harvest sales may be conducted on stands as young as 60 years old during the first decade for landscape manipulation. The analysis team defined stand age for this analysis at 70+ years rather than 60+ as stands because this is typically more desirable silviculturally, and culmination of mean annual increment is more probable.

GIS analysis also determined the potential acreage available for commercial thinning on matrix lands using the following criteria: 1) stand age = 20-70 years; 2) 40% and greater stocking; 3) contains conifers and 4) either outside or inside Riparian Reserves. The analysis indicated that using these criteria there is a total of 3,846 acres potentially available for harvest (Map 15). For a more complete breakdown of commercial thinning opportunity acreages see Chapter 1, Commodity Forest Products.

To project opportunities for the next decade, analysis used the same criteria, except for changing stand age from 60 to 70 years. An additional 877 acres will be potentially available for regeneration harvest within the next 10 years (Map 16).

Silvicultural Projects

The RMP defines target decadal acreages for various silvicultural treatments for the resource area. Matrix in the analysis area accounts for 29% of total Matrix acreage for the resource area. A proportionate treatment acreage for the analysis area was calculated using 29% of the RMP target treatment acreage for the Marys Peak resource area. It was not possible to take into account age class distribution when determining RMP target acreage for the analysis area.

Information contained in microstorms data base and various criteria for identification of projects were used to further refine possible decadal treatment acreages.

Early silvicultural projects are identified by vegetation surveys. The following describes the criteria that is used to identify early silvicultural treatment projects:

Site Preparation
Purpose: To reduce competing vegetation and logging debris (also reduces fire hazard), to provide room for seedlings to be planted, to lessen competition to seedlings from other vegetation, and to limit cover for seedling-damaging rodents. Site preparation methods include prescribed fire, manual vegetation cutting, hand piling / burning in fall, and mechanical clearing.

In certain locations, close proximity to the Willamette designated airshed may preclude use of prescribed burning. Alternatives are available, as well as higher utilization standards during actual logging and yarding practices.

Criteria for identification of projects:

1) Stands which have been regeneration harvested within the last year.
2) Hardwood conversion areas: areas which are currently growing hardwoods, but which have the potential to grow a conifer stand.
3) Stands planned for understory development/creation of second canopy layer.

RMP target for site preparation in the Marys Peak Resource area calls for treatment on 2,340 acres for the current decade. The above criteria for identification of projects and information generated in microstorms indicates that within the analysis area 230 acres should actually receive treatment during the current decade. Since 1995, no acres have actually received site preparation treatment in the analysis area although 45 acres are scheduled for treatment during 1997.

Reforestation

Purpose: To plant regeneration harvested sites, within one year if possible, after site preparation has been completed. Plant with genetically selected seed where possible. The selection of tree species, density and stock type will depend on the site characteristics, stand composition and future project management objectives.

Criteria for identification of projects:

1) Stands which have been recently regeneration harvested, and site preparation recently done.
2) Hardwood conversion site which has been prepared for planting.
3) Stands identified for understory development (generation of second canopy layer).

RMP target for reforestation in the Marys Peak resource area calls for planting 1,310 acres this decade with regular seedlings and 270 acres this decade with genetically improved stock. The above criteria for identification of projects and information generated in microstorms indicates that within the analysis area an average 170 acres should be planted yearly with regular planting stock and 60 acres should be planted yearly with genetically improved planting stock during the current decade. During the period 1995 to 1997, 32 acres were actually planted with regular planting stock.

Stand Maintenance and Release

Purpose: To provide sufficient light and growing space for growing conifer seedlings.

Criteria for identification of projects:

1) Select units where hardwoods overtop conifers or where competing brush or conifers threaten the survival or decreases the growth of preferred conifer seedlings.
2) Select stands 5-10 years of age for best results.
3) Treat between June and August for best effectiveness of treatment of hardwoods.
4) Treat before conifer growth has slowed significantly.

RMP target for manual maintenance in the Marys Peak resource area calls for treating 4,350 acres per decade. The above criteria for identification of projects and information generated in microstorms indicates that within the analysis area 320 acres should receive manual maintenance per decade. During the period 1995 to 1997, 113 acres actually received manual maintenance in the analysis area.

Pre-commercial Thinning

Purpose: To promote desired species composition, stem quality, spacing, and growth performance in young stands by reducing the stem count. Typical spacings are 12 to 16 feet.

Criteria for identification of projects:

1) Stands with non-preferred species composition.
2) Over stocked stands, generally stands with stem counts over 300.
3) Stands 10-20 years old have usually reached the necessary height and crown closure to allow conifer release without also releasing competitive species.

The RMP target for pre-commercial thinning in the Marys Peak resource area is 8,450 acres per decade. The above criteria for identification of projects and information generated in Micro-storms indicates that within the analysis area 590 acres should be pre-commercially thinned per decade. During the period 1995 to 1997, no acres were actually pre-commercial thinned in the analysis area.

Stand Protection

Purpose: To provide protection to seedlings from rodents and big game through the use of plastic tubing or netting around seedlings, or by trapping.

Criteria for identification of projects:

1) Units where animal damage to planted seedlings is severe.
2) Units where stocking levels have fallen below desired levels due to animal damage.

The RMP target for animal protection in the Marys Peak resource area is 3,230 acres per decade. The above criteria for identification of projects and information generated in microstorms indicates that within the analysis area 100 acres should receive animal protection treatment per decade.

<u>Fertilization</u>

Purpose: To stimulate good health and additional growth of conifer trees.

Criteria for identification of projects:

1) Lower site class land and at higher elevation where soil nitrogen levels are low.
2) Stands with slash build up following a thinning.
3) Timing of fertilization should be 10-20 years before the next thinning or final harvest to maximize the return from the treatment.
4) Minimal ground cover so that fertilizer reaches the seedling roots.

The RMP target for fertilization in the Marys Peak resource area is 1,930 acres per decade. The above criteria for identification of projects and information generated in microstorms indicates that within the analysis area 560 acres should be fertilized each decade.

<u>Pruning</u>

Purpose: To enhance future log quality.

Criteria for identification of projects:

1) Stands with young trees; age 15 to 50 years; may be performed several times.
2) Trees should be at least 4 inches diameter.
3) Trees with good growth form and minimal defect should be selected for treatment.
4) Best return is found on high site class land.
5) Stands that have been recently thinned.

The RMP target for pruning in the Marys Peak resource area is 1,200 acres per decade. The above criteria for identification of projects and information generated in microstorms indicates that within the analysis area an average 350 acres should be pruned each decade.

Hardwood Conversion

Purpose: To convert hardwood dominated sites to conifer species.

Criteria for identification of projects:

1) Hardwood dominated stands which have the site potential to grow conifers
2) Best return if stands are near planned thinning or regeneration harvest sales which could be performed as part of those sales.
3) If converting red alder, best results if treated between mid-May and mid-July, an eight week period starting after bud break.

Special Forest Products

Special Forest Products (SFP) are limited to vegetative material and include such items as grasses, seeds, roots, bark, berries, mosses, ferns, edible mushrooms, tree seedlings, transplants, conifer boughs and sap, poles and firewood. The top three SFP, based on volume and monetary value, are salal, mushrooms and firewood.

Management of SFPs is an important component of ecosystem-based resource management. An effectively managed SFP program benefits both the BLM and the public. Such a program can complement other resource programs managed by the BLM; contribute to the economic stability of local communities; resolve some of the conflicts created by increased commercial and recreational harvesting of these forest products; develop baseline inventory data for species now in demand; form partnerships with groups concerned with the harvest and management of these products; and educate the public as to the value of natural, renewable resources.

The Benton Foothills analysis area, in general, has not experienced a heavy demand for SFP. However, in recent years the Salem District has experienced an increase in interest and demand for all SFP offered for sale on the district. Many users drive through the analysis area to gain access to SFP sites in the interior coast range watersheds around the Alsea valley. Below is a summary of permits issued in the analysis area from January 1 through December 31, 1996.

Product	Permits Issued*	Amount*	Revenue Generated*
Chanterelle mushrooms	45	4,395 pounds	$537.42
Salal	8	4,900 pounds	$405.58
Conifer boughs	2	10,500 pounds	$225.50
Firewood	8	11 cords	$139.45
Beargrass	2	3,100 pounds	$34.00
Transplants	1	100 each	$11.00

Douglas-fir pitch	1	15 gallons	$33.00
TOTALS	**67**		**$1,385.95****

* Data reflects collections in the analysis area only. ** 10% of total is a road use and maintenance fee for the removal of SFP.

While a written contract or permit is required for the severance and/or removal of any SFP, reasonable amounts of commonly available, renewable resources such as flowers, berries, nuts, seeds, cones and leaves for non-commercial use may be harvested without a written contract or permit. Reasonable amounts for non-commercial free use have been established for the products listed below.

Special Forest Product	**Unit of Measure**	**Reasonable Amount** (Per Person Per Year)
Beargrass	Pounds	25
Berries	Gallons	5 per species
Conifer Boughs	Pounds	25
Cones - Ornamental	Bushels	2
Cones - Seed	Bushels	1
Greenery - all types	Pounds	25
Moss	Pounds	25
Mushrooms	Gallons	5 per species*
Firewood		**

* Oregon State Law states, in part, that a written permit is required from the owner of the land from which mushrooms are harvested unless the total volume of mushrooms harvested is less than one gallon. In other words, only one gallon of free use mushrooms per person can be transported on state roads per trip. ** Free use firewood consists of limbs, branches, or other woody debris for campfires on public lands only.

Transportation

The eastern (valley) portion of the Benton Foothills analysis area is accessed by a network of roads administered by Benton County; the western (forested uplands) via roads controlled by the BLM and industrial timber companies. Within those forested uplands, approximately 34 miles of road are controlled by BLM and 191 miles by private timber companies. Of the BLM administered roads, approximately 26 miles (or 76%) are surfaced with crushed aggregate, and 8 miles (23%) are natural (dirt) surface.

The transportation system within this analysis areas forested uplands was originally constructed for management of BLM-administered and private timberlands, as well as provide access to a few scattered homesteads. Management activities included timber harvest and salvage operations, fire prevention and suppression, and timber stand improvements. These were the only reasons the private controlled roads were constructed and the primary reasons those roads continue to be maintained today. Though the BLM roads were constructed for the same reasons, public use is now a factor in determining what level of maintenance to apply to each road segment.

Another determinant influencing the standard at which bureau roads will be maintained is that the majority of BLM lands are designated as matrix. For that reason, and because private landholders need to retain access to their lands, the need remains to maintain and occasionally upgrade roads passing through federal lands.

Secondary roads are routes frequently used for transportation of forest products or dispersed recreation that have a definite terminus. These roads are generally surfaced with crushed rock and are maintained annually or during sustained timber hauling. Because most of the secondary roads in this area were built between 1940 and 1970, impacts on the landscape were greater than would occur using today's construction methods. Over time, these roads have stabilized and present minimal risk to water quality if routinely maintained.

Local roads are usually short (1 mile or less) and access specific resource management units where use is limited to short-term transportation of forest resources. Road surfaces can consist of either rock or natural surface. Typically these roads are only maintained for commercial use. The primary problem encountered is runoff and scouring from native surfaced roads on steeper gradients, especially those used by off-highway vehicles (OHV).

The few roads constructed on BLM after 1975 were designed to follow the natural contours of the landscape, avoided placing embankment material on steep slopes, more carefully considered drainage needs, and rocked the running surface. The recently completed inventory of analysis area roads revealed some additional items/issues worthy of consideration. Those include:

C **Drainage Structures**: Because of the advanced age of many structures, replacements are needed. There are a number of culverts which have rust deteriorated bottoms or other damage that requires attention. Many other culverts are inadequate to handle 100-year flood events. Also, the few original log structures remaining from the railroad era are in various stages of collapse; some on long abandoned spurs have breached the fill and stabilized, while others need attention before the same occurs.

C **Road Surface**: With the absence of anadromous fish in the streams and the lack of drainage into municipal water systems, the consequences of road sediment is not as critical as in other watersheds. The sediment issue must still be addressed though, and appropriate measures taken when funding opportunities arise. However, when weighing the benefits of funding improvements in this analysis area versus those drainages with anadromous fisheries, those with fisheries would likely be selected. The most direct source of sediment comes from non-surfaced roads crossing intermittent or perennial streams. The problem is complicated by OHV rutting the natural (and to a lesser degree aggregate surfaced) roads on steeper road gradients. Aggregate and maintenance are the two most important ingredients in minimizing surface erosion.

C **Road Closures**: Historically, roads controlled by the BLM have remained open for public use, except for occasional periods of extreme fire danger. Excluding the few cases where the BLM has acquired exclusive easements across private lands, public access across private lands is not guaranteed. Therefore, any road (or road segment) under private control can be closed to the public whenever the private party determines closure is necessary. If, however, the road is encumbered by a reciprocal agreement or non-exclusive easement, administrative use is assured to all participating parties. This would effectively eliminate only the public use.

Because of the proximity of the uplands to valley communities, a significant number of visitors utilize the transportation system to engage in dispersed recreational activities including motorcycle riding, hunting, shooting, camping, sightseeing, firewood cutting, mushroom picking, etc. These activities are fine in their own right, however, when dumping and damage of property occur, limiting access results. Recent restrictive measures have been taken by various landholders to reduce such abuses.

C **Road Maintenance**: The maintenance responsibility for all roads lie with the controlling party. BLM secondary roads are generally well maintained during periods of commercial use but otherwise receive infrequent attention. These roads are maintained to provide management access to both BLM and private lands. But with the trend toward reduced federal harvests, additional deterioration of roads and their structures is occurring. The few recent BLM timber sales in the area have added some surface rock and replaced deficient culverts. This method of upgrading will continue as opportunities arise.

Recreation

To date, the BLM has not placed an emphasis upon developing a recreational plan for the Benton Foothills analysis area, instead allowing the public to establish it's own uses. Considering the topography and geographical features, development would likely be limited to maintaining or enhancing those existing uses described below.

Fishing

Based on an interview with Steve Mamoyac, a Fisheries Biologist for Oregon Department of Fish and Wildlife, recreational fishing use in this analysis area is insignificant. The streams have no known anadromous fisheries, and access is limited by the large amount of private ownership.

Some local residents fish these streams on a limited basis.

Hunting

The following is a summary of the big game presence, recreational use of big game and possible impacts on big game from other recreational uses within the Benton Foothills analysis area. The information sources are Dr. Doug Cottam, District Wildlife Biologist for the Oregon Department of Fish and Wildlife (ODFW) and Garth Ross, Marys Peak Resource Area Wildlife Biologist for the BLM. The following information was obtained through aerial and spotlight surveys of deer and elk, contacts with local game officers and hunters, and personal observations from current and past ODFW and BLM staff.

The analysis area has a relatively high density of black-tailed deer hunted fairly intensively by residents of the local communities. The deer have a reputation of large trophy bucks, especially on BLM land near the Bellfountain road. Where access is available, this analysis area provides high quality deer hunting given the current availability of habitat types. Roosevelt Elk numbers are low but increasing. Local landowners hunt these elk intensively without much success. The further west into the coastal mountains, the higher the density of elk. Mr. Ross explained that deer and elk adapt well to human disturbance, and it is unlikely that the area's current recreational activities will adversely affect their numbers or movements.

Bear and cougar exist within the analysis area but their numbers are low and very little, if any, hunting occurs for these species.

There are two furbearers, beaver and bobcat, that occur in relatively high numbers in the analysis area. Both species are trapped and hunted although these forms of recreation have few participants. The local bobcat size is reputed to be large.

There is also hunting of upland game birds such as valley quail, mountain quail, and wild turkey in the analysis area. Few ring-necked pheasant now occur in the Willamette Valley at all. Dr. Cottam expects to see a gradual increase in the turkey population in the area, though not convinced the turkeys will utilize the coastal fir zones.

Mountain Biking

Though present use appears limited to occasional biking events, the potential exists for increased usage when considering the availability of roads and trails as well as the proximity to population centers. At this time, however, motorcycles dominate the same facilities that would interest mountain bikers. A potential for conflict exists should mountain bikes attempt to make an inroad into motorcycle areas.

Motorcycle Use

Approximately 17 miles of native surfaced roads and 9 miles of trails are known to be used by motorcycle riders within this analysis area, almost exclusively on BLM and Starker Forest lands. As the gradient increases, soil displacement occurs from tires digging for traction and subsequent transport of unincorporated fines during runoff periods. Due to continuing physical disturbances, vegetation in these areas is incapable of restoring stability. The Flat Mountain Riders Association has been attempting, with some success, to reduce impacts by constructing various draindip, ditch, and simple bridge structures to help minimize motorcycle impacts.

Dr. Cottam expressed a concern that mountain biking, off-road motorcycling and other motor vehicle based activity may negatively affect elk in the analysis area. He would also like to avoid recreational activities in the coastal mountain areas that would force disturbed elk onto the valley floor where conflicts with farming activities could occur.

Pleasure Driving

Though unmonitored, visitors frequently engage in pleasure driving through forested areas. The upkeep of roads and signs, as well as the availability of transportation maps, is all that is necessary to accommodate these users.

Special Forest Products

Picking one pound or less of mushrooms for personal use is presently allowed without a permit. A relatively high number of recreational users probably take advantage of this opportunity.

Land Tenure

Reference Conditions

Not applicable to land tenure.

Current Conditions

Land tenure adjustment to benefit a variety of uses and values is an approved objective in the Salem District Resource Management Plan (RMP) (see Appendix 1). All of the BLM-administered land in the analysis area is designated in the RMP as Land Tenure Zone 2. In this zone, tracts can be exchanged to block up in Zones 1 and 2.

In the higher elevations of the analysis area, sections of BLM-administered land are intermingled with sections of private land. One private timberland owner (Starker Forest Products) has submitted a proposal to exchange BLM and private lands in the analysis area for purposes of blocking up ownerships and improving management efficiency. Other timberland owners may have similar interests.

Several of the smaller tracts in the lower elevations of the analysis area are completely surrounded by private lands and may be suitable for exchange to block up in other areas of the Matrix.

Rural Interface Areas

Reference Conditions

See Pre-EuroAmerican Settlement discussions.

Current Conditions

Rural interface areas (RIA) are BLM-administered lands and adjacent or intermingled private lands which are either zoned for development of rural residences or already developed with rural residences. RIA are found throughout the lower elevations of the analysis area. (Map 17). Most of them are along county and BLM roads in the narrow valleys which extend into the Coast Range foothills. Some of the private lands in RIA are highly desirable for residential use.

This use is a concern to BLM for three major reasons:

1. homes and lot sizes impede efficient management of BLM-administered forest lands;
2. some RIA property owners, especially residents, object to forest management activities and public uses and take actions to stop or change these activities and uses; and
3. the cost of wildfire suppression is greatly increased when dwellings are present.

Based on these concerns, management actions/direction for BLM-administered lands in RIA were developed (see Salem District Resource Management Plan p. 39). The essence of this guidance is reflected in the following RIA objective:

Consider the interests of adjacent and nearby rural land owners, including residents, during analysis, planning and monitoring of projects and activities in rural interface areas. These interests include personal health and safety, improvements to property, and quality of life. BLM will determine how land owners might be or are affected by activities on public lands.

Major RIA in the analysis area are:

1. Lower one mile of Botkin Road: 10-to-20 houses with access from a BLM road
2. Reese Creek Road: unknown number of residences
3. Beaver Creek Road: unknown number of residences
4. Alpine area: extensive zoning for rural residential development; unknown number of residences

The only RIA where residents have expressed major concerns is Botkin Road. Residents have been concerned about maintenance of the BLM road (dust, potholes, washboarding, flooding of road surface, speeding vehicles, etc.), effects of timber harvest and road construction on their lands (blowdown and stream siltation), dumping on public lands, and shooting over homes. BLM has responded to these concerns by increasing road maintenance, replacing a culvert, blocking spur roads where dumping and shooting were taking place, and posting signs to slow traffic.

In the other RIA, some residents are concerned that timber harvest has increased flooding. This concern has not been verified by studies or research.

During the public involvement process for land use planning in the Muddy Creek watershed (1996), four issues predominated; read each as if it begins "Desire for:"

1. Maintaining rural character
2. Less burdensome land use regulations
3. Increased summer stream flows
4. Enhanced fish habitat

(Personal communication with Dr. D. Hulse; presentation by Dr. Hulse at Linn-Benton Community College, January 1997).

Unauthorized/Unmanaged Uses

Industrial land owners and BLM are concerned with increases in dumping, vandalism, and shooting. (See Transportation, Road closures section also).

Visual Resource Management

Reference Conditions

Not applicable to Visual Resource Management

Current Conditions

The analysis area is primarily VRM Class 4 lands (6,057 acres) in which management activities may dominate the view and be the major focus of viewer attention (Map 18).

Approximately 92 acres of VRM Class 2 lands are located in the Hammer Creek subwatershed. Management activities may be seen but should not attract the attention of the casual observer.

Chapter 5&6 - Findings and Recommendations

Recommendations apply only to BLM lands. BLM will work cooperatively with private landowners whenever and wherever feasible to implement the intent of the following recommendations.

Soil Compaction and Erosional Processes

1) **Finding:** Ground-based tractor yarding has occurred on approximately 5,900 acres of forested uplands, exclusive of agricultural lands, in this analysis area. This has resulted in about 1,530 acres of soil compaction (see Chapter 3/4 - Erosional Processes).

Soil compaction and related loss of site productivity has increased in the post-settlement period, in contrast to reference conditions. This increase has resulted primarily from forest harvest and road construction activities. Soil compaction impacts potential vegetation cover and productivity. It can impact potential timing and peak flows of streams when the compacted areas are connected to roads and streams. See Appendix 7 for a further discussion of off site effects from soil compaction. Recent concerns about impacts from soil compaction have resulted in practice changes and mitigation. These actions should reduce soil compaction and related surface runoff.

Recommendations:

- Reduce areas of existing soil compaction, especially those areas that are non-vegetated and/or contributing to off-site stream impacts.
- Reduce road densities where possible especially those roads that are impacting streams and contributing to off-site impacts.
- Where possible, avoid stream disturbing activities and heavy hauling during rainy periods when high runoff is occurring.
- Where possible, avoid practices that remove surface vegetation cover, soil litter and duff.
- Mitigate any new soil compaction, especially where the compaction connects to roads or streams (i.e. skid roads connected to access roads; landing size).

2) **Finding:** Within the Benton Foothills analysis area, there is an area containing many geomorphic shapes that suggest past or present instability. The area, located Southeast of Flat Mountain, covers approximately 6 square miles, see Map 19 for location. This is an area of naturally occurring soil creep and slump-earth flow with varying rates of movement. Movement occurs during periods of saturated soil conditions, driven primarily by annual variations in

precipitation. Movement is accelerated during peak rainfall years. Typically the least well drained areas (furthest from well-defined drainages) have the most rapidly moving slides. These comprise a very small percentage of the delineated area. Movement of soil into streams occurs by two methods:

1.) Slump-earth flows, *periodically* contribute large quantities of soil to streams.
2.) Soil creep results in slow *chronic* movement of soil into streams.

On-site impacts from failures can be a reduction in surface and subsurface drainage resulting in areas of wet or saturated soils. An increase in water tolerant vegetation will be apparent at these locations. Soil creep will be manifested in trees with curved areas at one or more points along the bole. Off-site impacts are primarily periodic or chronic inputs of sediments into streams.

Recommendations:

- Update TPCC mapping early in the project planning stage and before implementation.

- Avoid road construction methods that divert intercepted subsurface and surface water onto unstable or potentially unstable areas.

- Where possible, avoid road and landing construction that under cut the lower portion (toe) of slump areas.

- Removal of trees will decrease the amount of evapotranspiration and increase the amount of late-season soil moisture and/or run-off by 20 to 24 inches during the growing season. Timber harvest should be avoided in highly unstable areas (see RMP, TPCC criteria and Best Management Practices (BMP) for additional management direction).

3) **Finding:** There are eight recognized debris avalanche slides in the analysis area; none are on BLM lands. During the last 46 years, seven slides have resulted from road-related activities. This low number is due to roads being placed away from high landslide potential areas. Accelerated debris avalanche landsliding is periodic and frequently is associated with inadequate road surface drainage that causes culverts and fills to fail. Cutting trees in steep headwall positions and at the toe of steep stream adjacent slopes increases the landsliding hazard.

Although harvest activities are expected to increase in the watershed, significant increases in land sliding rates are not expected. This is due to the limited amount of high hazard areas, an awareness of the relationship of how and where failures occur and new watershed protection requirements.

On-site impacts from landsliding are primarily a loss of soil that results in a loss of productivity. Off-site impacts result from a surge of soil materials and debris that scours stream channels just below the failure. Much of the material is deposited in the flatter gradient portion of the stream. This action removes much of the riparian zone vegetation and changes channel geometry.

Recommendations:

C Apply practices that reduce the amount of surface runoff from roads and landings that directly enter streams:

a. Redistribute intercepted subsurface flows on the hillslopes.
b. Mitigate areas of soil compaction that are contributing surface runoff to streams.

.C Avoid tree removal on high landslide hazard stream adjacent slopes and headwalls.

C By avoiding activities in highly unstable areas and diverting water away from road fills, sediment discharge into streams will be greatly reduced.

4) **Finding:** Surface erosion by water and dry-raveling is a natural process that occurs primarily on hillslopes with gradients in excess of 60%. Surface erosion is accelerated when low growing ground cover and/or duff layer are removed. This occurs to some degree following activities such as burning, yarding logs and road excavation. Most of the activities now occurring on steeper lands in the analysis area are thinning, regeneration harvests or spring burning for site preparation. All of these activities leave the majority of the soil surface protected or undisturbed.

Soil surface erosion (dry raveling) stresses plants by exposing roots when soil is removed from around them, or by covering plants down slope when eroded soil is deposited on them. Eroded materials are moved directly down hillslopes and eventually deposited in headwall areas of stream channels.

Recommendations:

C Conduct operations to minimize soil and litter disturbance. Any operations that expose mineral soil, especially adjacent to roads and streams, should include plans to restore vegetation cover or divert water away from streams.

5) **Finding:** GIS data shows no lands steeper than 90% in the watershed. However there are approximately 40 acres with slopes at or above 90% in T.13S., R.6W., Section 7, that have been identified in the field. These acres have been removed from the production base. With further investigations, more lands may be identified with TPCC restrictions.

Recommendations:

C As new information is obtained, continue to up-date land use maps with most accurate data to comply with TPCC system.

Vegetation

1) **Finding:** The fifth field Marys River Watershed encompasses 5,444 acres of federal forests over 80 years of age in Late-Successional and Riparian Reserves (486 acres of BLM-administered land and 4,958 acres of U.S. Forest Service land). These acres are approximately 35 percent of the total federal forested acres in the watershed.

Of the total acres, at least 3,527 acres are in excess of 120 years of age, comprising 23 percent of the watershed. Based on recent field surveys in the watershed, these 120 year-old and older stands are assumed to provide the structural attributes desired by late-successional associated species. Many of the other stands (80-120 years) are probably on a satisfactory trend to provide suitable late-successional characteristics in the future, but these stands were not analyzed since the 15-percent rule is already met by the 120 year-and-older stands. The stands used to meet the 15-percent rule are scattered throughout the watershed, although most are located in the Late-Successional Reserve on Marys Peak.

The analysis area is part of the Marys River Watershed. Since the 15-percent rule is met in the Marys River Watershed in Reserves, older forest stands in the analysis area Matrix do not need to be reserved.

Recommendations:

- Work with USFS to map stands contributing to the 15 percent rule.

2) **Finding:** Late-successional forest (80 years and older) comprises about 503 acres in the analysis area. By the year 2030 (approximately), this amount should increase by an additional 376 acres in LSR and about 1,300 acres in Riparian Reserves.

Ingrowth in Late-Successional Reserves and Riparian Reserves will result in the additional acreage. Not all acres of Riparian Reserves will produce late-successional forest habitat because of site conditions such as excessively wet soils. The figure for Riparian Reserves was estimated based on the current age and structure of forests in Riparian Reserves and assuming adequate growth and structural development.

Recommendations:

- Thoroughly inventory forests within Riparian Reserves to confirm estimates on late-successional forest trajectories.

- Conduct exams in a selected sample of these stands to determine structural characteristics that would provide goals for management of younger-aged stands.

- Conduct conifer releases in areas with dense red alders.

3) **Finding:** 5,773 acres of stands occur on Matrix lands in the analysis area. These stands are generally lacking in snags and decay classes one, two and three coarse woody debris. Many of these stands (especially the 20-60 year age class) also tend to have low botanical diversity due to the dense overhead canopy.

Most of these stands developed following timber harvesting. They tend to be densely stocked stands with relatively few standing snags. Large green wolf trees occur within some of these stands as a result of past timber harvest practices or fire events. Large dead and downed material is generally available in these stands as legacies of previous stands, although most are in decay classes four and five. Future recruitment is dependent upon meeting ROD standards for coarse woody debris in Matrix stands.

Management of stands in the Matrix will involve such activities as precommercial thinning, manual release, commercial thinning, and regeneration harvest with provisions for retention of large green trees (6-8/acre), snags (2/acre or at 40% of potential woodpecker population level), and coarse woody debris (240 lineal feet with minimum size for individual pieces of 20 inches diameter at breast height (dbh) and 20 feet long).

Recommendations:

- Identify and mark green trees for snags and downed wood recruitment in upland regeneration project areas with stands at least 70-80 years old. This age approximates the development of larger (approaching 20 inches dbh) trees which produce the minimum size of snags and downed wood, i.e., 20 inches dbh, important to the forest ecosystems in northwestern Oregon.

- In project areas between 20 and 70 years old, thin trees to increase growth and wood volume production and enhance species composition.

- Conduct conifer releases in areas with dense red alders.

4) **Finding:** An estimated 39.5 acres (plus an additional 40 acres of shallow soil areas which may provide some important plant habitat) of special vegetation types (e.g., seasonal and permanent wetlands, open water areas, natural brushy openings) occur on BLM-administered lands within the analysis area. Special vegetation types on private lands (primarily on agricultural lands on the valley floor) also contribute about 465 acres of wetland-marsh; 6,295 acres wetland - riparian with trees; and 298 acres of open water.

Data for BLM-administered lands reflects interpretation of BLM's TPCC (Timber Production Capability Class) system which considered only the capability of the land to grow trees rather than other plant life. Thus, they are just estimations of the amount of special vegetation types. Data is not available to confidently predict a trend in the amount of this habitat over time. The best estimate is that the current acreage is less than in presettlement times due to brush encroachment on meadow sites subsequent to establishment of effective fire control methods.

Recommendations:

C Maintain and/or enhance existing special vegetation types in order to provide diverse habitats.

C Consider preparing a prescribed fire research plan to learn more about control of brushy and/or competing non-native species in small, selected areas where such treatment may be necessary.

C Inventory to determine amount, location and size of special vegetation areas.

5) **Finding:** Several special attention plant species have been located within the analysis area (primarily Reese Creek subwatershed).

These include: Fungi - *Cantharellus cibarius, C. subalbidus, C. tubaeformis, C. formosus, Clavariadelphus truncata, Endogone oregonensis,Gymnopilus puntifolius, Gyromitra esculenta, Helvella elastica, Helvella maculata, Hydnum repandum, Otidea onotica,Phaeocollybia attenuata, Phaeocollybia fallax, Phaeocollybia sipei, Phaeocollybia olivacea, Ramaria sp., Sarcosoma mexicana, Sparassis crispa, Thaxterogaster sp.* nov. # Trappe 4867, 6242; Lichens - *Lobaria oregana, L. pulmonaria, Nephroma helveticum, N. laevigatum, N. resupinatum, Peltigera pacifica, Pseudocyphellaria anomola, P. anthraspis, P. crocata, Sticta fuliginosa, S. limbata*.

Recommendations:

C Manage habitat for these species according to Salem District RMP.

C Continue surveys for special attention plant species; record and store locations in a database; and eventually develop a GIS layer.

6) **Finding:** Four broad plant association types were identified for the analysis area based on their importance to ecosystem management (see Chapter 3&4 - Vegetation).

Recommendations:

C Assist in the development of a plant association layer at the provincial level. The BLM should help fund efforts to produce this layer at the provincial level; upon its completion assess the suitability of this layer at the watershed level. Such information will enable us to make better predictions on future stand compositions and conditions as well as addressing potential management problems and opportunities.

7) **Finding:** Five species of noxious weeds are known to occur in the analysis area (see Chapter 3&4-Vegetation), and they have spread to recent harvested areas and some special

vegetative communities.

Recommendations:

- Follow RMP guidelines to control noxious weeds.

- Use native plant species when available in the revegetation of disturbed areas. If these species are not available, use revegetation methods that do not encourage the introduction or spread of invasive non-native plant species.

- Inventory the analysis area to determine the extent of noxious weed infestations.

Riparian Reserves

1) **Finding:** BLM Riparian Reserves in the analysis area lack older forest characteristics. Approximately 1,636 acres (78%) of the Riparian Reserves are in early and mid seral age stands, between ages 20 and 70. Many of these stands tend to be overstocked, and lack vertical structure. Stand exams have been done on approximately 800 acres in the Riparian Reserves. The results are shown in Table 10.

TABLE 10. RESULTS OF 1996 STAND EXAMS IN RIPARIAN RESERVES

LOCATION	AGE	MEAN DBH	TREES PER ACRE	RD[1]
T13S-R6W-7-020,040	55	13.7	348	0.96
T13S-R6W-17-010	45	14.4	190	0.57
T13S-R6W-17-080,100	45/65	9.3	542	0.84
T13S-R6W-31-010,040,100	65	16.1	172	0.61
T13S-R7W-25-020	55	14.4	224	0.67
T14S-R6W-5-040,050,100,200	65	15.8	248	0.85
T14S-R6W-5-090	65	15.7	183	0.62

[1] RD (Relative Density) is a ratio: Trees per acre in a stand, adjusted to a 10 inch diameter; divided by the trees per acre of a fully stocked stand, 10 inches in diameter (595 for Douglas-fir). 0.35 is the point where growth slows from competition. 0.6 is the point where competition begins to cause mortality.

Recommendations:

C Following guidelines in Table 12, consider the above stands for density management treatments.

C Inventory other stands between ages 20 and 70 to determine if they are developing older forest characteristics, and if they would benefit from density management or some other treatment to maintain or restore Aquatic Conservation Strategy (ACS) objectives.

2) **Finding:** 16% of the BLM Riparian Reserves are in hardwood dominated stands. Many of these acres are narrow strips along streams which pose no barrier to LWD recruitment, stream shading, or development of older forest characteristics. Others occur on relatively broad flood plains with high water tables, where conifer stands do not naturally develop. There are other areas where there may be opportunities for restoration/enhancement projects.

Recommendations:

C Following the guidelines in Table 12, the following reaches should be examined for enhancement opportunities:

  C Oliver Creek in T.14S., R.6W., Sec.5: Release western red cedar, possibly underplant western red cedar in some spots.
  C Oliver Creek in T.13S., R.6W., Sec.31: Replace hardwoods with conifers.
  C Green Peak in T.14S., R.6W., Sec.7: Release western red cedar and western hemlock.
  C Horse Pasture in T.13S., R.6W., Sec.25: Release conifers.

3) **Finding:** There have been no data collected from stands over age 80 in the Riparian Reserves. Some may be developing older forest characteristics and may be able to serve as reference riparian stands.

Recommendations:

C Inventory stands over age 80, looking at stands along lower gradient streams first.

C Inventory Forest Peak Area of Critical Environmental Concern to determine if it would be suitable to use as a reference reach.

4) **Finding:** Coarse woody debris (CWD), or down wood and snags, are an important component of the Riparian Reserves. Informal reconnaissance in the analysis area indicates that there is generally a sufficient amount of CWD in decay classes three through five, but no formal data exists. Stand exams done to date do not provide sufficient data.

Recommendations:

C Inventory down wood and snags in the Riparian Reserves.

C Using Table 11, design management activities in the Riparian Reserves to provide for down wood and snags in all decay classes over the life of the stand.

Management goals for the Riparian Reserves are aimed at developing older forest characteristics, much like the goals for Late Successional Reserves (LSR). The analysis team reviewed the draft LSR Assessment for the Oregon Coast Province, Southern Portion (LSRA 1996), as a guide in developing recommendations for CWD in Riparian Reserves. The LSRA recommends ranges of CWD, depending upon site specific conditions. Fire history in the analysis area indicated that CWD would historically be at the low end of these ranges. Therefore, the team chose the low end of the LSRA recommended range as the beginning point for our recommendations, expecting that interdisciplinary teams at the project level would increase that number if site conditions require so.

The team believes that many stands will come close to the LSRA minimums with the CWD that is already there in decay classes three through five. Our primary concern is with leaving sufficient wood in decay classes one and two. In smaller diameter stands, it will be necessary to leave most of the hard snags and down wood as green trees in order to provide for large hard CWD over the life of the stand. The team therefore emphasized long term treatment prescriptions and monitoring plans to cover all activities over time to achieve CWD and other goals for the stand.

There is a concern that felling large numbers of green trees will in some cases increase populations of Douglas-fir beetles (*Dendroctonus pseudotsugae*) to levels that will cause damage to living trees and adversely affect the achievement of management objectives in the Riparian Reserves. The team therefore took into consideration guidelines which have been developed for the Siuslaw National Forest (Hostetler 1996) in designing our CWD recommendations.

TABLE 11. COARSE WOODY DEBRIS RECOMMENDATIONS FOR MANAGEMENT ACTIVITIES IN THE RIPARIAN RESERVES

CWD	Stands under 12" DBH	Stands 12" to 20" DBH	Stands over 20" DBH
Snags	There may be some contracts in younger stands where the contractor wants trees as small as 6" DBH. In that case the treatment prescription will require creation of snags and down wood in a later treatment when stand DBH is over 12".	Protect existing snags, where safety allows. Maintain a minimum of 2 per acre in the largest diameter class, creating them where necessary.	Protect existing snags where safety allows. Maintain a minimum of 2 per acre, (at least one being a hard snag), creating them where necessary.

CWD	Stands under 12" DBH	Stands 12" to 20" DBH	Stands over 20" DBH
Down Wood	Same as for snags	Inventory what is already in the stand. If the stand has the LSRA minimum, but it includes no hard down wood over 12", fell and leave another 3-5 trees over 12", or as large as possible. Because hard down wood over 20" is the ultimate goal, leave enough green trees to create these in the future. The treatment prescription and monitoring plan will include subsequent treatments.	Inventory what is already in the stand, including all decay classes with a 4 inch minimum log diameter. Fell enough trees to increase down wood to the LSRA minimum. To insure enough wood in decay classes 1 and 2, drop an additional amount to meet the matrix minimum (240 linear feet, over 20" DBH).

5) **Finding:** Management activities in the Riparian Reserves can be used to promote older forest characteristics, attain ACS objectives and move the Riparian Reserves on a trajectory toward older forest characteristics. Desired riparian characteristics (see Appendix 8) include:

- Diverse vegetation appropriate to the water table, geomorphic land type and stream channel type;
- Diverse age classes (multi-layered canopy);
- Mature conifers where they have occurred in the past;
- Dead standing/down wood;
- Stream connected to its flood plain (flood plain inundated every 1-3 years);
- Stream bank vegetation with adequate root strength to maintain bank stability.

Recommendations:

- Use Table 12 as a guide when considering management activities in the Riparian Reserves.

Management Priorities:

- Areas of connectivity to adjacent watersheds.
- Riparian areas where inchannel improvement is planned or has been completed.
- Areas adjacent to private lands.
- Areas where other timber management is planned.

TABLE 12. CRITERIA FOR MANAGEMENT ACTIVITIES IN THE RIPARIAN RESERVES

CURRENT CONDITION	MANAGEMENT ACTIVITIES
Mixed hardwood/conifer stands or pure hardwood stands	
C No conifer stumps present/no evidence that conifer is suited to the site or historically present	C No Treatment
C Conifer stumps present/ Conifers overtopped by dense hardwood canopy	C Release and/or under plant conifers. Decision to treat and the treatment prescription will be determined on a site specific basis. Treatment will be appropriate to the geomorphic context of the site and objectives will be based on the site' s physical and biological potential.
Conifer stands less than 20 years old	
C Dense uniform stands	C Control stocking to maintain growth of dominant trees and maintain health of stand. Prescription will be determined on a site specific basis and may include a range of spacing densities for each site. Minor species in the stand, including hardwoods, will be maintained. Some conifers may be released to an open- grown condition to promote wolfy limbs.
C Stands with a large component of hardwoods	C Release conifers to maintain a conifer component in the riparian reserves.

CURRENT CONDITION	MANAGEMENT ACTIVITIES
Stands 20-70 years	
C Previously thinned stands, or stands with natural openings where a conifer understory is initiating, and overstory canopy is closing.	C Manage density to encourage understory growth. Prescription will be determined on a site specific basis and may include uneven spacings, a range of densities, small patch cuts, small unthinned patches, and opening up specific trees to encourage wolfy limbs. Maintain minor species and trees with desirable wildlife characteristics, including hardwoods. Leave enough green trees to ensure standing/down dead wood recruitment. Remove merchantable material in excess of standing/down dead wood criteria (see Table 11), and where it poses a forest health hazard (excess fuel loading, Douglas-fir bark beetle or black stain infestation). Prescriptions will include all subsequent treatments to maintain understory growth, achieve dead down/standing wood goals, achieve older forest characteristics, or any other identified goals.
C Fast growing stands with relative densities over 0.35[1]	C Thin to maintain fast growth of dominant trees. Prescriptions will be determined on a site specific basis and may include any of the above treatments, as well as underplanting and subsequent density management to maintain understory growth.
Stands over 70 Years	
C Overstocked, even-aged stands with more than 150 trees per acre and/or relative densities greater than 0.35	C Manage density to maintain fast growth of dominant trees. Prescription to be determined on a site specific basis, and may include any of the treatments for younger stands, including underplanting.
C Previously treated stands with stagnating understory conifers	C Manage density to encourage understory growth. Prescription to be determined on a site specific basis and may include any of the treatments for younger stands.

[1] See Footnote, Table 10.

Other Management Activities in the Riparian Reserves

- Fire: Prescribed fire can be used at any age to achieve management objectives within the guidelines of the RMP.

- Special Forest Products: The guidelines set out in the district environmental assessment will be followed in the Riparian Reserves.

- Salvage:

    - The RMP will be followed, and logs will only be salvaged if required to attain Aquatic Conservation Strategy objectives.
    - Coarse woody debris will be left on the site to meet the goals in Table 11.
    - A site specific analysis will be done by an interdisciplinary team.
    - If salvage is required, yarding will be from existing roads.

Hydrology

1) **Finding:** Precipitation, streamflow and peak flow events are approximately half the magnitude of those occurring just west of the drainage divide in the Alsea watershed. Additionally, rain-on -snow events are limited to small areas of Flat Mountain on the forested uplands of Beaver and Reese Creeks.

Recommendations:

- Environmental assessments of proposed projects should identify the proportion of project area in transient snow zone (TSZ). Minimize permanent road construction in these areas and schedule projects to maintain low proportion of TSZ areas in 0-10 year age classes. Consider decommissioning roads and trails in these areas, particularly on unstable sites.

2) **Finding:** Land management practices have likely altered hydrologic processes in the watershed from reference condition. Ground based harvesting systems and road construction have historically been the greatest contributor to these "cumulative effects" to hydrologic processes in the forested uplands. Trends have likely been partial recovery towards a new equilibrium somewhat degraded from reference conditions.

Recommendations:

- Preferentially use aerial and cable-based harvesting systems. Reduce road surface area and locate new road construction on ridge tops, where possible. Roads that are not necessary for long-term stand management should be decommissioned after use.

- For new road construction, implement RMP Management Actions/Direction (p. 62) including:

- minimize road and landings locations in Riparian Reserves;
- minimize disruption of natural hydrologic flowpaths, including diversion of streamflow and interception of surface and subsurface flow;
- avoid wetlands entirely when constructing new roads.

3) Finding: Reduced summer base flows coinciding with high demand and use of surface water are likely to be a limiting factor for water quality and surface water beneficial uses (i.e., aquatic function, domestic water, recreation, livestock, etc.) particularly in the lowland agricultural portions of the watershed.

Stream Channels

1) **Finding:** Land management practices have altered stream channel form and function in the watershed from reference condition. These alterations have contributed to the degradation of water quality and aquatic habitat. Conditions and trends are specific to channel type, as follows:

"Depositional" channels (primarily the Muddy Creek mainstem) are aggraded (bed elevation is increasing as sediment deposits) and, likely, widening. Overbank (flood plain) flow occurs commonly as the channel adjusts to large sediment loads from tributary streams. Maintenance of riparian vegetation is critical to the stability of these channels. The trend is for continued lateral and horizontal instability in response to continued high sediment loads.

"Response" channels (primarily in the agricultural lowlands) are incised and moderately to highly unstable. Channels are "disconnected" from their flood plains (overbank flooding occurs only during extreme storm events, if at all) which now primarily function as terraces. Water storage in flood plains has been reduced, contributing to the reduction in summer base flows. The trend is for continued bank cutting and lateral instability as channels develop a new equilibrium.

Source and transport channels (mostly in the forested uplands) have higher sediment loads and reduced roughness, particularly LWD. On stable channels, sediment is being quickly transported downstream and channels are degraded to bedrock. Unstable channels (primarily on Flat Mountain) are aggraded and, in some cases, widening. Unstable channels in these positions are particularly sensitive to the condition of vegetation on adjacent hills lopes. The long-term trend (next 100 years) is for slow recovery to a new equilibrium as large woody debris increases and channels adjust to higher sediment loads.

Recommendations:

- Roads that cross stream channels currently utilized by beaver, particularly dammed areas, should be identified. Road maintenance at these sites, including dam removal or destruction, should not proceed without approval by the fisheries biologist, wildlife biologist, hydrologist or road engineering staff in the Marys Peak Resource Area.

C Harvest planning should consider the potential for falling or placing conifer in the stream channels to improve channel function and aquatic habitat.

C Conduct in-stream inventory of all low gradient reaches on the BLM to determine functional condition.

Water Quality

1) **Finding:** Water quality in the watershed is probably moderately to highly degraded from reference condition. However, there is not enough data to verify this. The following four parameters are of the greatest concern for maintenance of water quality for aquatic function, domestic use, livestock, and recreation:

C Suspended sediment and turbidity during much of the winter, particularly in the agricultural lowlands (data is available which supports this). Trend is for continued high levels, particularly of fines, due to bank erosion, surface erosion from agriculture, forest roads and trails, and "natural" background sources;

C Stream temperature and dissolved oxygen during summer base flow, particularly in the agricultural lowlands (some data available, not enough to verify this). Trend is for maintenance of stream temperatures and dissolved oxygen in the forested uplands, trends in the lowlands are unknown; and,

C Coliform bacteria, possibly other infectious microorganisms, particularly in the agricultural lowlands during summer base flow (some data available, not enough to verify this). The trend is for this to continue unless actions are taken to protect surface water from livestock, increase base flow, and increase vegetative cover in riparian zones in these areas.

2) **Finding:** Reese Creek, Beaver Creek, and mainstem Muddy Creek appear to have the poorest water quality conditions overall.

Recommendations:

C Monitor stream temperatures in the summer of 1997 below Super Hammer thinning.

3) **Finding:** Water quality conditions in the forested uplands appear to be generally good, but there is little data to verify this. The parameter of greatest concern is turbidity and suspended sediment, particularly chronic inputs of fine sediments from road and trail surfaces.

4) **Finding:** The overall basin trend is for increasing pollutant levels, particularly from rural development in the lowlands, with the potential for even greater degradation of water quality and impacts to beneficial uses.

Confidence in Analysis

Alterations from "reference conditions" are hypothetical and primarily based on professional estimates, deductions, and extrapolations from regional research. Data to test these hypotheses, or to establish trends, is extremely limited. Overall, the material in this section is adequate for broad planning purposes, but site-specific data and recommendations are necessary to apply conclusions from this section.

Fish Species and Habitat

1) **Finding**: Oregon chub, an Endangered Species Act listed species, occur in the analysis area in the Upper Muddy Creek sub-basin. Oregon chub habitat does not occur on BLM-managed land.

Recommendations:

- BLM will follow RMP guidance for Aquatic Conservation Strategy until the Oregon chub Recovery Plan is completed; the recovery plan would then be implemented. Road no.13-6-25 is not critical for access needs; closure would minimize potential for risk to chub habitat on lands downstream of the headwaters.

2) **Finding:** Fish presence occur within 239 miles of stream in the analysis area; BLM manages 21.2 miles. Fish habitat surveys are completed on 9.5 miles on BLM.

Recommendations:

- Complete habitat surveys on BLM lands. Work with other agencies, industries, and private land owners to gain missing data for private lands in the analysis area.

3) **Finding:** Habitat data is limited on public and private lands. Data to establish overall habitat condition for the analysis area is not available.

Recommendations:

- Fill data gaps. Where little or no data exists, recommendations should be made at the project level.

4) **Finding:** Surveys indicate streams are not properly functioning in terms of large woody

debris, pool area and pool quality on BLM lands.

Recommendations:

- When management activities occur that involve tree falling in riparian areas near streams, fall trees into the stream. All activities conducted by BLM should be mitigated to prevent degradation to the stream channel as recommended by the RMP and ROD (BMP and Aquatic Conservation Strategy).

Wildlife Species and Habitat

1) **Finding:** The analysis area has been converted from an oak-savannah habitat type in the lowlands and a late-seral forest in the uplands into a younger-aged Douglas-fir dominated forest.

Recommendations:

- Protect existing, dry oak sites to provide habitat for those species associated with this habitat. Reserve scatted old growth trees and large downed wood within harvest units.

2) **Finding:** One spotted owl pair is nesting in the Benton Foothills analysis area. Species that require large amounts of late seral and old growth habitat were probably never abundant within this analysis area.

Recommendations:

- Thin LSR and Riparian Reserves to accelerate older forest habitat within the analysis area. Protect existing remnant old-growth component.

3) **Finding:** The analysis area has little remaining late-seral and old-growth habitat.

Recommendations:

- Leave one-half of the reserve trees on every regeneration harvest area scattered across the unit.

4) **Finding:** Dispersal by highly mobile species and habitat to allow dispersal to adjacent areas is not a significant issue within the analysis area.

Recommendations:

- Retain connective dispersal habitat in Riparian Reserves.

5) **Finding:** Special habitats appear to be a relatively minor component within the analysis area with the exception of some small wetlands.

Recommendations:

- Protect existing wetlands.

6) **Finding:** There are no known sites for special attention species within the analysis area.

Recommendations:

- Actively survey areas that appear to contain habitat for special attention species.

Human Uses

Commodity Forest Products

1) **Finding:** Sold or planned regeneration timber harvest in the analysis area fulfills approximately *68% of the resource area decadal commitment. **The decadal annual sale quantity from this analysis area is estimated to be 30 percent. Annual sale quantity estimates the allowable harvest levels that could be maintained over the long term. One regeneration sale in the 60 year age class and a replacement volume sale account for the inflated percentage of volume towards the decadal commitment from this analysis area. Approximately 60% of the regeneration decadal commitment in the next decade will come from the analysis area. This is supported by the high amount of acreage currently in the 60 year age class moving into the 70 year age class next decade, thus potentially available for regeneration harvest.

*Note: 11.7 MMBF sold or planned for the analysis area (1995-2004) / 17.289 MMBF decadal commitment = 68% of decadal commitment.

**Analysis was done using TRIM PLUS modeling based on 70 year and older conifer and 50 year and older hardwood.

Recommendations:

- Because of past prctices, the age class distribution is not even across the landscapes. Consider deferring further regeneration harvest in the analysis area until next decade when the 60 year age class moves into the 70 year age class, unless resource impacts in other watersheds are at higher risk as compared to this low impact analysis area.

2) **Finding:** Sold or planned commercial thinning within the analysis area fulfills

approximately *65% of the resource area decadal commitment. **The decadal annual sale quantity from this analysis area is estimated to be 47 percent. Approximately 20% of commercial thinning volume in the next decade will come from the analysis area. The opportunities for the next decade may be greater than TRIM Plus projections because of the acreages moving into the 30 and 50 year age classes (especially if considering double entry thinnings).

*Note: 5.189 MMBF sold or planned for the watershed (1995-2004) / 7.963 MMBF decadal commercial thinning commitment = 65% of decadal commitment.

**Analysis was done using TRIM PLUS modeling based on 40 to 60 year age classes.

Recommendations:

- Limit commercial thinning in those stands targeted for single entry until next decade.

- Accelerate stand exams in stands showing potential for producing resource benefits. If we find that there are more stands than projected, adjust the RMP annual sale quantity.

3) **Finding:** Plantation maintenance and release needs have been reduced considerably by large service contracts and by a reduced regeneration harvest. RMP estimates based on the analysis acres tend to be higher than data base (micro-storms (M*S)) records from surveys indicate. Also, brush competition is not as severe a problem in the analysis area as in other resource area watersheds. The stands in the analysis area therefore, require fewer acres of maintenance and release treatments. Few acres in the analysis area have been given seedling protection treatment over the last ten years.

Recommendations:

- Proceed with intensive silvicultural practices to maximize quality and production.

4) Finding: Late-Successional Reserve acres account for approximately 8% of the BLM land in the analysis area. The Oregon State University research project is proposed to treat approximately 102 acres this decade.

Recommendations:

- See Research section.

Special Forest Products

1) **Findings:** Special forest product collections in the analysis area and in the Marys Peak Resource Area are minor. Products are available in this analysis area but are generally harvested in the South Fork Alsea watershed. Reasons for this may include: BLM lands are blocked up in

the South Fork area making it easier to identify BLM lands, and the vegetation may be of better quality along the lower elevations of the South Fork Alsea River.

Recommendations:

- Follow the district RMP, special forest products handbook and the Marys Peak Resource Area categorical exclusion for guidance on the sale of special forest products.

- Provide educational materials on the collection of SFP and make available to the public.

Transportation Management

1) **Finding:** Drainage structures on many of the BLM controlled roads are deteriorating and/or are inadequately sized for 100-year flood events.

Recommendations:

- See Appendix 9 for a prioritized list of potential culvert replacements on BLM controlled roads. That list contains approximately twelve existing culverts that are deteriorating. An additional eight culverts were identified as inadequate in the road inventory process and will be replaced by either the BLM maintenance crew or in association with planned timber sales. Another twenty-one culverts were found to need some form of maintenance to return them to full capability.

2) **Finding:** Approximately 1.65 miles of unsurfaced roads provide legitimate year-round administrative traffic that results in soil displacement (i.e., wash, tires ruts, etc.) when used during wet periods. Roadbed rutting on natural surfaced roads used by OHV is occurring attention requiring attention.

Recommendations:

- See Appendix 9 for a prioritized list of recommended BLM road segments where surface rock should be placed and surface drainage devices (i.e. waterbars, draindips, etc.) installed. Appendix 10 lists roads where measures to restrict access should be taken. Whenever possible, these improvements will be accomplished in conjunction with timber sale activities, otherwise, when funding sources become available (Map 20).

3). **Finding:** Due to lack of maintenance, some ditches, catch basins, and culvert inlets have obstacles obstructing seasonal flows. These include bank ravel, slash, or other forms of debris that can effectively dam the water course diverting it onto road surfaces or over embankments where erosion can occur.

Recommendations:

C Identify areas where the likelihood for drainage problems exists and establish a means for rating risk potential (both probability and potential). The rating would be included in the Transportation Management Objectives (TMO) data base and would indicate which sites require more frequent field inspections and drainage repair.

4) **Finding:** Four log drainage structures were located on BLM lands during the road inventory process. All of these structures are well beyond their design life and have either collapsed or are in the process of doing so. The identified structures are all located on roads that are long abandoned or have not received commercial use in decades.

Recommendations:

C Road 13-6-15 has two failed log structures on Duffy Creek tributary streams, and Road 13-6-27 has two log structures in the process of failing on a Starr Creek tributary stream. All four are earmarked for removal, the creeks restored to their natural streambeds, and the roadbeds obliterated and grass seeded whenever a funding opportunity becomes available (see Appendix 10, Prioritized List of Roads for Potential Closures).

5) **Finding:** In general, avoid new road construction in riparian reserves to meet Aquatic Conservation Strategy objectives. The current planning process for new road construction requires the involvement of affected resource specialists, including the hydrologist, soils scientist, botanist, wildlife biologist and/or aquatic biologist, and road engineer. At the present time, the Best Management Practices are being used to help determine the road location, general road design features, design of cross drains and stream crossings, as well as the actual road construction.

Recommendations:

C Continue this interdisciplinary process of evaluating each new road proposal, and when needed, utilize specialists from outside the agency to verify findings.

C When interdisciplinary teams are considering proposals for constructing road crossings on stream channels (as defined in the ROD), the Benton Foothills analysis area team has recommended the following methodology be used:

Rosgen (Applied River Morphology, Chapter 6, 29-33) has published a method for characterizing channel stability which combines his channel classification system with the Pfanuck stability index. This approach requires a field visit to the sites in question and the end product is a channel stability rating of: poor fair or good. By combining this rating with a matrix which identifies the beneficial uses identified in the watershed, a numerical "Risk Rating" from 1 to 12 can be displayed, as below:

Beneficial Use	*Good Stability*	*Fair Stability*	*Poor Stability*
Extremely High	9	11	12
High	6	8	10
Moderate	3	5	7
Low	1	2	4

The beneficial use rating is as follows:

Extremely High = Habitat for listed species or a combination of two or more high uses.
High = Anadromous fishery or municipal watershed or combination of two or more moderate uses.
Moderate = Domestic water supply, non-anadromous fish, recreation.
Low = Irrigation, livestock, or other.

This rating does **not** imply that the crossing can or cannot be constructed in a manner that will preclude direct, indirect or cumulative effects; the potential for effects must be identified in the environmental assessment document, as always. The rating does provide a consistent and reproducible method for assigning risk, and it allows for a comparison of relative risk levels from project to project.

The recommendation is that this method be applied on an interim basis to test its usefulness by interdisciplinary teams considering proposals for road construction across streams. This approach will also be presented to the District Soil-Water Working Group for evaluation and adaptation.

Recreation:

1) **Finding:** Use of public lands by off-highway vehicles is extensive and virtually unmanaged.

Recommendations:

C Designate a trail system which will be managed for off-highway vehicle use and protects other resource values.

a. Complete a survey/inventory of all OHV trails on the BLM in Benton County and determine trail condition, with emphasis on trails within riparian reserves and at stream crossings.

b. Work with the Flat Mountain Trail Riders group, Starker Forest Products, Inc., and other individuals/groups to develop and implement a trail and maintenance plan. This plan would address:

C Improve stream crossings on the designated system.

- C Repair damaged segments of the designated system.

- C Close trail segments which are not part of the designated system.

- C Monitor use to ensure resource conditions on the trail system meet Aquatic Conservation Strategy objectives.

c. Marys Peak Resource Area should identify an individual to work directly with the groups to develop and implement the recommended plan of action.

2) **Finding:** The transportation system is used for a variety of recreation activities. Other than maintenance of roads, improvements to facilitate recreation use are nonexistent.

Recommendations:

- C Install and maintain road signs on BLM-controlled roads.

- C Develop Memorandums Of Understanding with private land owners to allow public access on key roads across private lands.

3) **Finding:** Competitive mountain bike events have been held in the north part of the analysis area. Interest has been shown in similar events in the Bellfountain area. These events need to be carefully planned by the sponsors and BLM to avoid conflicts with motorized vehicles and to minimize resource impacts.

Recommendations:

- C Follow BLM procedures for granting permits for these events.

- C Work with the sponsors to locate sites and trails for the events. Health and safety of riders and spectators and protection of public resources should be overriding concerns.

- C Monitor sites and trails before, during, and after the event.

Research

1) **Finding:** Density management research is being planned for the Green Peak LSR block. This will be a long-term project.

Recommendations:

- C Promote additional research in this block only if it is compatible with the current project.
- C Screen all proposed management projects against the research plan and allow projects which are compatible with research.
- C Assist the researchers with design, field layout, data collection, and monitoring as appropriate.

Land Tenure

1) **Finding:** The analysis area is in Land Tenure Zone 2, as designated in the RMP/ROD. Lands within this zone may be blocked up in exchange for other lands in Zones 1 or 2, transferred to other public agencies, or given some form of cooperative management.

Recommendations:

- C Scattered tracts in T.13S., R.6W., Sections 13, 15, 23, 25, 27 and 35.
  - a. Conduct an inventory to determine whether these tracts should or should not be kept as BLM-administered land; consider significant ecological values.
  - b. Proceed with exchange or transfer of tracts which should not be kept as BLM-administered land.
- C Large checkerboard blocks in west part of analysis area
  - a. Identify areas which could benefit from blocking up public lands. Acquisition of T.14S., R.6W., Sec.6 would block up LSR lands. Acquisition of T.13S. R.6W, Sec.30 would enhance riparian reserve connectivity on Oliver Creek.
  - b. Identify areas where blocks could be given up for exchange; inventory for significant ecological values.

Rural Interface Areas

1) **Finding:** Several rural interface areas extend up drainages to a short distance from public land. A ROD/RMP objective is to consider the interests of adjacent or nearby rural land owners when planning and implementing management activities.

Recommendations:

- Contact neighbors during project planning and determine their interests and concerns regarding the proposed activities.

- Develop design features and mitigation measures that will minimize the possibility of conflicts with our neighbors (see ROD/RMP, p.39, for suggested features and measures.)

- Monitor the effectiveness of design features and mitigation measures during and after project implementation.

Unauthorized / Unmanaged Uses

1) **Finding:**
Industrial land owners and BLM are concerned with increases in dumping, vandalism, and shooting.

Recommendations:

- Continue to identify areas that are used for dumps, shooting, and vandalism.

- Clean up dump areas, block spurs used for shooting, and keep law enforcement informed.

Visual Resource Management

1) **Finding:** The analysis area is primarily VRM 4 lands, with a small acreage (92 acres) of VRM 2 lands.

Recommendations:

- Follow RMP guidelines.

References

Agee, James K. 1993. Fire Ecology of Pacific Northwest Forests. Island Press.

Andrews, H. J. and Cowlin, R. W. 1936. Forest Type Map State of Oregon. USDA Forest Service Pacific Northwest Forest Experiment Station.

Baldwin, Kathryn A. 1982. Making the Most of the Best. Willamette Industries Inc. Albany, Oregon.

Benda, Lee. 1990. The Influence of Debris Flows on Channels and Valley Floors in the Oregon Coast Range, U.S.A. Earth Surface Processes and Landforms, Vol 15, 457-466.

Beschta, R.L. 1979. Debris Removal And Its Effect On Sedimentation In An Oregon Coast Range Stream. Northwest Science, vol., 53. no. 1. p.71-77.

Beschta, R.L. 1981. Turbidity And Suspended Sediment Relationships. Proc. Sym. Watershed Mgmt. A.S.C.E. p.271-282.

Bodhaine. G.L. and D.M. Thomas. 1964. Magnitude and frequency of floods in the United States. Part 12. Pacific Slope basins in Washington and upper Colombia River basin. U.S.G.S., Water-Supply Paper 1687.

Boyd, Robert. 1986. Strategies of Indian Burning in the Willamette Valley. Canadian Journal of Anthropology 5:65-86.

Brown, G.W. 1980. Forestry And Water Quality. O.S.U. Book Stores Inc. Corvallis, Oregon. pp.142.

Bureau of Land Management. 1996. An Assessment of Bank Erosion in the Oliver Creek Sub-basin, Muddy Creek Watershed. Unpublished report by Marys Peak Resource Area Hydrologist, Patrick Hawe. Salem, OR.

Christy, John. 1996. Oregon Natural Heritage Program. Unpublished manuscript.

Dahl, T.E. 1990. Report to Congress: Wetland Losses in the United States; 1780s to 1980s. USDI Fish and Wildlife Service, Washington D.C. 28 pp.

Dahl, T.E., and C.E. Johnson. 1991. Status and trends of wetlands in the contiguous United States, mid-1970s to mid-1980s. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C.

Dietich, W. E. and Dunne, T. 1978. Sediment Budget for a Small Catchment in Mountainous Terrain. Z Geomorph. N. F. Suppl. Bd. 29 191-206 Berlin - Stuttgart.

Dyrness, C. T. and D. N. Swanston. 1973. Stability of Steep Land. Journal of Forestry 71(5).

E&S Environmental Chemistry, Inc. 1996. Water Quality Sampling of Muddy Creek Watershed, Benton County, Oregon. Corvallis, OR.

Federal Interagency Committee for Wetland Delineation. 1987. Federal Manual for Identifying and Delineating Jurisdictional Wetlands. U.S. Army Corps of Engineers, USDA Soil Conservation Service, U.S. Fish and Wildlife Service, and U. S. Environmental Protection Agency. Washington D.C. Cooperative Technical Publication. 76 pp plus appendices.

Forest Ecosystem Management Assessment Team. 1993. Forest Ecosystem Management: An ecological, economic, and social assessment. V25-V29.

Frissell, C.A. Nawa, R.K. 1992. Incidence and Causes of Physical Failure of Artificial Habitat Structures in Streams of Western Oregon and Washington. North American Journal of Fisheries Management 12:182-197.

Gannett, Henry. 1902 The Forests of Oregon. USDI United States Geological Survey. Professional Paper No. 4. Washington Government Printing Office.

Grant, G. E. & A.L. Wolff. 1991. Long-Term Patterns of Sediment Transport After Timber Harvest, Western Cascade Mountains, Oregon, USA. from Sediment and Stream Water Quality in a Changing Environment: Trends and Explanation (Proceedings of the Vienna Symposium, August 1991). IAHS Publication no. 203.

Gregory, S.V.; Lambertti, G.A.; Erman, D.C., (and others). 1987. Influence of forest practices on aquatic production. Pages 233-256 in: Salo, E.O.; Cundy, T.W., eds. Streamside management: forestry and fishery interactions. Contribution 57. Seattle, WA: University of Washington, Institute of Forest Resources.

Hankin, D.G. and G.H. Reeves. 1988. Estimating total fish abundance and total habitat area in small streams based on visual estimation methods, Canadian Journal of Fisheries and Aquatic Sciences 45: 834-844.

Haynes, H.B.N.1970. The ecology of running waters. University of Toronto Press.

Hicks, B.J.; Beschta, R.L.; Harr, R.D. 1991b. Long-term changes in streamflow following logging in western Oregon and associated fisheries implications. Water Resources Bulletin 27(2):217-226.

Hostetler, B. and Ross, D. 1996. Generation of coarse woody debris and guidelines for reducing the risk of adverse impacts by Douglas-fir beetle. Westside Forest Insect and Disease Technical Center. Unpublished.

Johannessen, C., Davenport, W., Millet, A., and McWilliams, S. The vegetation of the Willamette valley in the Annals of the Association of American Geographers, 61 (1970), 286-302.

Jones, J.A. and G.E. Grant. 1995. Peak Flow Responses to Clearcutting and Roads in Small and Large Basins, Western Cascades, Oregon. Draft.

Minore, D. and H. Weatherly. Riparian trees, shrubs, and forest regeneration in the coastal mountains of Oregon. 1994. New Forests 8: 249-263.

Mintonye, Edna A. 1968. They Laughed Too. The Naylor Company, San Antonio, Texas.

Montgomery and Buffington. 1993. Channel Classification, Prediction of Channel Response, And Assessment Of Channel Condition. Report TFW-SH10-93-002, Washington State Fish And Wildlife Agreement.

Morris, W. G. 1934. Forest fires in western Oregon and western Washington. Oregon. Historical Quarterly. 1935(4)

Moser, S., and J. Farnell. 1981 “Yamhill River Navigability Study.” Oregon Division of State Lands. Salem , Oregon.

Nickelson, T.E., M.F. Solazzi, S.L. Johnson, and J.D. Rodgers. 1992a. Seasonal changes in habitat use by juvenile coho salmon (Oncorhynchus kisuch) in Oregon coastal streams. Can. J. Fish. Aquat. Sci. 49:783-789.

Oregon Department of Environmental Quality. 1996. Oregon’s 1996 Water Quality Status Assessment Report 303(d).

Oregon Department of Forestry. 1997. Oregon Forest Practices Administrative Rules and Abridged Forest Practices Act. Chapter 629:29-53.

Power, W. E. 1974. Effects and Observations of Soil Compaction in the Salem District. Technical Note T/N - 256, Denver Service Center, Federal Center Building 50, Denver CO.

Ripple, William J. 1994. Historic and Spatial Patterns of Old Forests in Western Oregon. Journal of Forestry 92:11. November 1994. 45-48.

Rosgen, David, L. 1994. A Classification of Natural Rivers. Catena. Vol. 22, No. 3. pp169-199.

Rosgen, David, L. 1996. Applied River Morphology. Wildland Hydrology, Pagosa Springs, Colorado.

Sedell, J.R. and K.J. Luchessa. 1982. Using the historical record as an aid to salmonid habitat enhancement. In: Arantrout , N.B., ed. Acquisition and utilization of aquatic inventory information: Proceedings of the symposium. Bethesda, MD. American Fisheries Society, Western Division. 210-223.

Swanson, F. J. and Grant, G. E. 1982. Rates of Soil Erosion by Surface and Mass Erosion Processes in the Willamette National Forest. Report on file - Forest Science Lab, USDA Pacific Northwest Research Station, Corvallis, Oregon.

Tappiener, J., Zasada, J., Ryan, P. and M. Newton. 1991. Salmonberry clonal and population Structure: the basis for a persistent cover. Ecology: 72(2): 609-618.

Teensma, P.D.A., J. T. Rienstra, and M. A. Yeiter. 1991. Preliminary Reconstruction and Analysis of Change in Forest Stand Age Classes of the Oregon Coast Range From 1850 to 1940. USDI Bureau of Land Management. Technical Note T/N OR-9. Portland, Oregon.

TFW 1994. Board Manual: Standard Methodology For Conducting Watershed Analysis. Under Chapter 222-22 WAC, Version 2.1. Washington Forest Practices Board.

Thompson, Gilbert., Johnson, A.J. 1900. Map of the State of Oregon showing the Classification of Lands and Forests. Oregon Department of Forestry, Salem, Oregon.

Towle, Jerry C., 1982. Changing Geography of Willamette Valley Woodlands published in the Oregon Historical Quarterly, Vol. 83, No. 1, Spring 1982, pp.66-87. Excepts from this article also included in “Backroads of Benton County: Alsea and Lobster Valleys” - Tour Guide Series, Horner Museum, Oregon State University, Corvallis, Oregon, 1982.

Trotter, P. C. Coastal Cutthroat Trout: A Life History Compendium. Transactions of the American Fisheries Society 118:463-473.

USDA 1993. A First Approximation of Ecosystem Health. National Forest System Lands Pacific Northwest Region.

USDA 1994. A Federal Agency Guide For Pilot Watershed Analysis. Version 1.2.

USDA Forest Service and USDI Bureau of Land Management. 1994. Environmental Assessment for the Implementation of Interim Strategies for Managing Anadromous Fish Producing Watersheds in Eastern Oregon and Washington, Idaho and Portions of California - Draft.

USDA Forest Service and USDI Bureau of Land Management. 1994a. Final Supplemental Environmental Impact Statement on Management of Habitat for Late-Successional and

Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl. Volume I and II (Northwest Forest Plan). Portland, OR.

_______. 1994b. Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl (ROD); and Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl (S&G). Portland, OR.

USDI Bureau of Land Management. 1995. Salem District Record of Decision and Resource Management Plan (RMP). USDI-BLM, Salem District, Salem, OR.81 pp.+Appendices.

U.S. Environmental Protection Agency. 1991. Monitoring Guidelines To Evaluate Effects Of Forestry Activities On Streams In The Pacific Northwest And Alaska, by Lee H. Macdonald. EPA-910-9-91-001.

U.S. Environmental Protection Agency. 1996. BASINS version1.0: Better Assessment Science Integrating Point and Non-Point Sources. EPA-823-R-96-001.

U.S. Geological Survey. 1984. Statistical Summaries of Streamflow in Oregon. Volume 2. Western Oregon. U.S.Geological Survey Open-File Report 84-454. pp.150.

U.S. Geological Survey. 1974. Ground Water in the Corvallis-Albany Area, Central Willamette Valley, Oregon. U.S.Geological Survey Water-Supply Paper 2032. U.S. Government Printing Office. Washington, D.C.

Walstad, John D., et. al. 1990. Natural and Prescribed Fire in Pacific Northwest Forests. Oregon State University Press, Corvallis, Oregon.

Wemple, B.C. 1994. Assessing the hydrologic role of logging-access roads in two large forested basins in the western Cascades of Oregon. M.S. Thesis, Oregon State University, Corvallis.

Wydoski, R.S. and R.R. Whitney . 1979. Inland Fishes of Washington . University of Washington Press, Seattle, Washington. 220 pp.

Zybach, R. 1988. The Great Fires of the Oregon Coast Range-1933. Unpublished manuscript. Oregon State University College of Forestry. Corvallis, Oregon.

List of Appendices

Appendix 1: Land Use Allocations

RMP Issue 4. Threatened and Endangered (and other Special Status/Attention) Species Habitat

Land allocations in the watershed analysis area which address the issue - all of the major land allocations in the resource management plan (RMP) are designed in part to benefit special status/attention species.

See map 1 for locations of the major allocations.

Management actions/direction which address the issue:

All lands will be managed in a manner that protects species (and their habitats) that are federally listed or proposed for federal listing.

All lands will be managed in a manner that avoids contributing to the need to list federal candidate species, SEIS special attention species, state-listed species, bureau sensitive species, and bureau assessment species.

See pages 28 - 33 of the RMP record of decision (ROD) for additional details.

Expected future conditions

Protection, management and conservation of federally-listed and proposed species and their habitats to achieve their recovery in compliance with the Endangered Species Act and bureau special status species policies.

Conservation of federal candidate and bureau sensitive species and their habitats so as not to contribute to the need to list and recover the species.

Conservation of state-listed species and their habitats to assist the state in achieving management objectives.

Maintenance or restoration of community structure, species composition, and ecological processes of special status plant and animal habitat.

Protection of bureau assessment an SEIS special attention species so as not to elevate their status to any higher level of concern.

RMP Issue 6. Visual Resources

Land allocations in the watershed analysis area which address the issue - VRM Class II areas, 92 acres; and VRM Class IV areas, 6,057 acres.

See map 18 for locations of these areas.

Management actions/direction which address the issue:

All lands will be managed in accordance with the objectives of the four management classes (see expected future conditions).

See pages 36 - 37 of the RMP ROD for additional details.

Expected future conditions

Retention of the existing character of the landscape in VRM Class II areas.

Partial retention of the existing character of the landscape in VRM Class III areas.

Major modifications of the existing character of the landscape in VRM IV areas.

Continuation of emphasis on management of scenic resources in selected high-use areas to retain or preserve scenic quality.

RMP Issue 9. Recreation Resources

Land allocations in the watershed analysis area which address the issue:

Recreation Management Category	Approx. BLM acres	Approx. BLM miles
Extensive Recreation Management Area	6,149	
Back Country Byways - Existing		0.5

Management actions/direction which address the issue.

Manage existing sites, trails, and special recreation management areas to enhance visitor recreation experiences and produce satisfied public land users.

Maintain public access to extensive recreation management areas consistent with other natural resource management objectives.

Manage off-highway vehicle use on BLM-administered lands to protect natural resources, promote visitor safety, and minimize conflicts among various users.

Promote the use and enjoyment of back country byways.

See pages 41 - 45 of the RMP ROD for additional details.

Expected future conditions

Provision of a wide range of developed and dispersed recreation opportunities that contribute to meeting projected recreation demand within the district.

Provision of non-motorized recreational opportunities and creation of additional opportunities consistent with other management objectives.

RMP Issue 10. Land Tenure

Land allocations in the watershed analysis area which address the issue:

Zone	Approximate BLM acres
1	0
2	6,149

Management actions/direction which address the issue:

Zone 1 - generally, retain these lands under BLM administration.

Zone 2 - block up areas in zone 2 with significant resource values and exchange other lands in zone 2 to block up areas in zones 1 and 2 with significant resource values.

Desired future conditions:

Reduction of the fragmented pattern of BLM-administered land.

Maintenance of significant and unique resource values under BLM-jurisdiction.

RMP Issue 11. Rural Interface Areas

Land allocation in the watershed analysis - no RMP mapped Rural Interface Areas.

See map 17 for rural interface area locations in the analysis area.

Management actions/direction which address the issue:

Work with local governments, land owners, and other parties to address issues of mutual interest in rural interface areas.

Use design features and mitigation measures to avoid or minimize impacts to health, life, property, and quality of life of BLM's neighbors.

See pages 34 - 40 of the RMP ROD for additional details.

Desired future conditions

Land management objectives of all parties interested in rural interface areas are understood and given fair consideration in determining appropriate management activities and uses.

Complaints, protests, appeals, and law suits regarding management activities in rural interface areas are unnecessary.

RMP Concern 1. Air Quality

Land allocations - none.

Management actions/direction which address the concern:

Reduce particulate matter emissions and impacts from prescribed burning by 50 percent from the baseline period (1976-1979).

Reduce broadcast burning in favor of lower intensity under burning.

Consider alternative emission reduction techniques whenever they are compatible with land allocation objectives and management actions/direction.

See pages 22 - 24 of the RMP ROD for additional details.

Expected future conditions

Attainment of National Ambient Air Quality Standards, Prevention of Significant Deterioration goals, and Oregon visibility protection plan and smoke management plan goals.

Maintenance and enhancement of air quality and visibility in a manner consistent with the Clean Air Act and the state implementation plan.

RMP Concern 2. Cultural Resources Including American Indian Values

Land allocation which address the concern - Known sites are mapped, and the information is available to BLM personnel involved in planning activities which might impact cultural resources.

Management actions/direction which address the concern:

Evaluated cultural resource sites to determine their potential for contributing to public, cultural heritage, and/or scientific purposes.

Address the management of cultural resources in watershed analyses and project plans.

Work with American Indian groups and other interested parties to develop partnerships to accomplish cultural resource objectives.

See page 36 of the RMP ROD for additional details.

Desired future conditions

Conservation and protection of cultural resource values for future generations.

Provision of information on long-term environmental change and past interactions between humans and the environment.

Fulfillment of responsibilities to appropriate American Indian groups regarding heritage and religious concerns.

RMP Concern 3. Special Forest Products

Land allocation - none.

Management actions/direction which address the concern:

Permit collection of special forest products when consistent with the overall objectives of the resource management plan, including maintenance of a sustainable supply of products.

Establish specific guidelines for management of individual special forest products using interdisciplinary review as needed.

See pages 49 - 50 of the RMP ROD for additional details.

Desired future conditions

Production and sale of special forest products when demand is present and where actions taken are consistent with primary objectives for a particular land allocation.

Use of the principles of ecosystem mangement to guide management and harvest of special forest products.

RMP Concern 3. Noxious Weeds

Land allocation - none.

Management actions/direction which address the concern:

Continue to survey BLM-administered lands for noxious weeds.

Use control methods which do not retard or prevent attainment of Late-Successional Reserve and Aquatic Conservation Strategy objectives.

Use integrated pest management methods to control populations.

See page 64 of the RMP ROD for additional details.

Desired future conditions

Containment or reduction of noxious weed infestations on BLM-administered lands using an integrated pest management approach.

Avoidance of the introduction or spread of noxious weed infestations in all areas.

RMP Concern 4. Fire/Fuels Management

Land allocation - none.

Management actions/direction which address the concern:

Address fire/fuels management for all land allocations as part of watershed analysis and project planning.

Minimize the negative impacts of wildfire on ecosystem management objectives.

Reduce fire hazard through methods such as prescribed burning, mechanical or manual manipulation of forest vegetation and debris, etc.

See pages 65 - 67 of the RMP ROD for additional details.

Expected future conditions

Provision of the appropriate suppression responses to wildfires in order to meet resource management objectives and minimize the risk of large-scale, high intensity wildfires.

Use of prescribed fire to meet resource management objectives.

Adherence to smoke management/air quality standards of the Clean Air Act and state implementation plan for prescribed burning.

Appendix 2 - Erosional Processes

The Benton Foothills analysis area is generally of low relief with one area of slump earth flow and slide prone terrain. Most of the subwatersheds were formed by past mass wasting events which occurred over many thousands of years when the slopes were much steeper. Two types of landslides typically occur in watersheds: debris avalanches and rotational slumps. Mass wasting by debris avalanching is the most catastrophic producer of sediment; it occurs primarily in headwalls, and on convex portions of resistant parent materials on hillslope gradients steeper than 60 percent. Steeper slopes and a larger source area above the headwall typically increase failure rates. Avalanche events are sudden and triggered by a rapid increase in precipitation (usually > 5 inches in 24 hours). A significant contributing factor for avalanche slope failures is the loss of tree root support resulting from tree mortality. The area of soil lost is usually less than 0.5 acres. Avalanche materials move into depositional areas along second- or third-order streams. Such materials can temporarily dam streams and influence the condition and functioning of adjacent riparian zones.

Mass wasting by rotational slump earth flows occurs over thin bedded sandstone and siltstone. These formations are permeable to water that allow deep weathering of soil parent material. Slump earth flows are features that cover many acres of land. They are typically found on hillslopes of undulating topography with gradients less than 60 percent. The process begins by downslope creep of materials that disrupts natural drainage. This disruption increases water in the slide material which speeds creep rates. Slope failure or slumping is initiated when soil pore water pressure increases in the slide toe and/or when soil weight above the toe reaches a critical level. Sliding hazard is increased from processes that add water to the slump by 1) increasing precipitation due to climatic influences or by 2) reducing transpiration from vegetation as a result of mechanical, climatic, or biological factors (e.g., logging, wind, and disease, respectively). Slump earth flows have a high impact on tree bole straightness and type of vegetation. When slumps reach streams, they become a chronic source of sediments.

Concave hillslope positions accumulate materials by dry-ravelling, a mechanical process in which materials are detached from the hillslope and move downslope into concave positions. These materials later become gravelly, highly productive soils. In contrast, convex slopes contain rock outcrops and soils with thin surface layers and shallow depths. These shallow soils support little vegetative cover, and are subject to surface erosion from overland flow, the major erosive process on stable hillslopes less than 60 percent. Loss of vegetative cover by fire or removal increases the surface erosion hazard.

Dry-ravelling of loose materials is primarily a physical hillslope process that moves materials downslope and delays vegetative growth. This process is slope driven. Areas at high risk for dry-ravelling can be delineated by assessing local topography and soil types.

Appendix 3 - Historic Vegetation Patterns

Insight into long-term historic vegetation patterns of the Oregon Coast Range has recently been provided in a study by Worona and Whitlock (1995). By analyzing the pollen and plant macrofossils contained in the sedimentary layers of Little Lake, adjacent to Triangle Lake (located about 13 miles southwest of Bellfountain, these authors have assessed the vegetation and climatic conditions for the Coast Range for the past 42,000 years. Their work is briefly outlined below:

- from 42,000 to 24,770 years Before Present (B.P.)
  - corresponds to the last part of the Olympia non-glacial interval
  - climate was cooler and wetter that today
  - open forest of western white pine, western hemlock, and true firs

- from 24,770 to 13,500 years B.P.
  - corresponds to the full glacial period
  - montane forest association develops
  - western hemlock, mountain hemlock, pine, and fir are prominent
  - Douglas-fir is notably absent from this period

- from 13,500 to 10,000 years B.P.
  - initial warming trend in this period featured some temperate tree species including Douglas-fir which becomes a major forest component about 13,500 years B.P.
  - a likely cooling trend from 11,000 to 10,500 years B.P.
  - western and mountain hemlock, pine, and spruce prominent during cooling trend

- from 10,000 to 4,500 years B.P.
  - corresponds to early Holocene period
  - Douglas-fir, red alder, and bracken fern are abundant implying more severe summer drought and frequent fires
  - pattern of cool moist winters and drier summers appears after 5,600 years B.P. with Douglas-fir, western hemlock, and western red cedar becoming dominant

- from 4,500 years to the present
  - Douglas-fir, hemlock, and cedar are dominant species
  - 2,800 years ago to the present Douglas-fir increases, while cedar decreases
  - past 2,800 years suggest reduced effective moisture in this region

Research by Worona and Whitlock (1995) points to the emergence of the present day western hemlock/Douglas-fir forests in this part of the Coast Range at about 5,600 years B.P. This time line confirms that the ecological processes and disturbance regimes which are characteristic of this major plant community have been operating in this region for several thousand years.

In addition to fire events discussed previously, there were several other natural disturbance factors that affected the vegetation of the Coast Range. Severe wind storms, landslides, insect outbreaks, and disease pockets affected the vegetation at various scales. While the Columbus Day storm of 1962 suggests that wind storms can affect large areas, more often these other disturbance factors had a localized impact on vegetation patterns, and they did not occur as multiple simultaneous events.

Appendix 4 - ROD Species Occurrence in the Benton Foothills Analysis Area

Occurrence information ,found in the column OC, was determined as follows:

Present (P): documented
Remote possibility (R):
Highly probable (H):
Unknown (U):
Suspected (S):

Elevation data, obtained from Appendix J-2 of the FSEIS, was determined to be:

l = below transient snow zone
m = transient snow zone
h = subalpine & alpine

Scientific Name	OC	Habitat	El	Seral Stage	Assoc. SP	Species Category
Albatrellus avellaneus	S	coastal		OG	conifer/hardwood mix	rare ecto-polypores
Albatrellus ellsii	S	coastal		OG	conifer/hardwood mix	uncommon ecto-polypores
Albatrellus flettii	S	coastal		OG	conifer/hardwood mix	uncommon ecto-polypores
Aleuria rhenana	U	well-developed forest litter	l,m,h		conifer	rare cup fungi
Aleurodiscus farlowii	U	on wood, humus, litter, & stumps				rare resupinates and polypore
Alpova alexsmithii	U			mat-OG	conifer	rare false truffle
Alpova sp. nov.# Trappe1966	U				conifer	rare false truffle
Arcangeliella sp. nov. #Trappe12359	S	old-growth legacy of coarse woody debris in fog belt	l,m	mat-OG	PISI,TSHE	undescribed fungal taxa
Asterophora lycoperdoides	U	fruit bodies of other fungi		LS		parasitic fungi
Asterophora parastica	U	fruit bodies of other fungi		LS		parasitic fungi
Baeospora myriadophylla	U	litter, humus or dead wood		LS	conifer	uncommon gilled mushroom
Balsamia nigrens	S	coarse wood, xeric forests	l			rare truffle
Boletus haematinus	U				Abies	rare boletes
Boletus piperatus	S	coarse woody debris	l,m	OG	conifers	low elevation boletes
Boletus pulcherrimus	S		l	mat-OG	conifers	rare boletes
Bryoria tortuosa	S	coast and mesic	l,m		oaks and conifers	rare forage lichen
Calicium abietinum	S			OG	conifer	pin lichens
Calicium adaequatum	S			OG	conifer	

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Scientific Name	OC	Habitat	El	Seral Stage	Assoc. SP	Species Category
Calicium glaucellum	S			OG		pin lichens
Calicium viride	S	humid forest conditions; substrate & texture specific		OG		pin lichens
Cantharellus cibarius, C. subalbidus, C. tubaeformis, C. formosus	D D D D	coarse woody debris	l,m	mat-OG	conifer/hardwood	Chanterelles
Catathelasma ventricosa	U	habitat not completely known				uncommon gilled mushrooms
Cetrelia cetrariodes	S	foggy, riparian OG-forest	l,m	OG	hardwood/conifers	riparian lichens
Chaenotheca brunneola	S			OG		pin lichens
Chaenotheca chrysocephala	S			OG		pin lichens
Chaenotheca ferruginea	S			OG		pin lichens
Chaenotheca furfuracea	S			OG		pin lichens
Chaenotheca subroscida	S			OG		pin lichens
Chaenothecopis pusilla	S			OG		pin lichens
Chamonixia pacifica sp. nov. #Trappe12768	S		l,m	mat-OG	TSHE, PISI, PSME	undescribed fungal taxa
Choiromuces alveolatus	S	coarse woody debris	h			rare false truffle
Choiromyces venosus	S		l,m		mixed conifer/hardwood	rare truffles
Chroogomphus loculatus	U		l,m	OG	Pinaceae	rare gilled mushrooms

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Scientific Name	OC	Habitat	El	Seral Stage	Assoc. SP	Species Category
Clavariadelphus truncata	D	cool/cold moist well-developed litter layer		LS	hardwood or conifer	club coral fungi
Clavicorona avellanea	S	large woody debris	l,m	LS		coral fungi
Clavulina cinerea	S	well-developed litter layer		LS		branched coral fungi
Clavulina cristata	S	well-developed litter layer		LS		branched coral fungi
Clavulina ornatipes	S	well-developed litter layer		LS		branched coral fungi
Clitocybe senilit	S	moist, with a deep humus and litter layer	l	LS	conifers	rare gilled mushrooms
Clitocybe subditopoda	S	moist, deep humus and litter layer	l	LS	conifers	rare gilled mushrooms
Collema nigrescens	S	foggy riparian forest	l,m	OG	QUGA	riparian lichens
Collybia bakerensis	U	recently fallen stumps and logs		LS	conifer	uncommon gilled mushrooms
Collybia racemosa	U	fruit bodies of other fungi		LS		parasitic fungi
Codyceps capitata	U	fruit bodies of other fungi		LS		parasitic fungi
Cordyceps ophioglossoides	U	fruit bodies of other fungi		LS		parasitic fungi
Cortinarius azureus	U	habitat requirements not known				uncommon gilled mushroom
Cortinarius boulderensis	U	habitat requirements not known				uncommon gilled mushrooms
Cortinarius canabarba	U	diverse OG forest, woody debris		LS	conifer	rare gilled mushrooms
Cortinarius cyanites	U	habitat requirements not known				uncommon gilled mushrooms
Cortinarius magnivelatus	U	habitat requirements not known				uncommon gilled mushrooms

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Scientific Name	OC	Habitat	El	Seral Stage	Assoc. SP	Species Category
Cortinarius spilomius	U	habitat requirements not known				uncommon gilled mushrooms
Cortinarius tabulariscyanite	U	habitat requirements not known				uncommon gilled mushrooms
Cortinarius valgus	U	habitat requirements not known				uncommon gilled mushrooms
Cortinarius variipes	U	diverse OG forest, woody debris		LS	conifers	rare gilled mushrooms
Cortinarius verrucisporus	S	montane	h			rare gilled mushrooms
Cudonia circinans	U	duff			conifers	rare resupinates and polypore
Cudonia monticola	U	duff		mat	conifers	rare resupinates and polypore
Cyphelium inquinans	S			OG		pin lichens
Cyphellostereum laeve	U	habitat requirements not known			mosses	moss dwelling mushrooms
Democybe humboldtensis	U	habitat requirements not known				uncommon gilled mushrooms
Dendriscocaulon intricatulum	R	wet, boreal riparian	l,m	LS	conifers	rare resupinates and polypores
Destuntzia fusca	S	Mature coastal forest	l,m	mat-OG	SESE,PSME,Abies, TSHE	rare false truffles
Destuntzia rubra	S	mature coastal forest	l,m	mat-OG	SESE,PSME,LIDE, TSHE	rare false truffles
Dichostereum granulosum	U	wood, humus, litter & stumps				rare resupinates and polypores
Diplophyllum plicatum	U	coastal forest; bark, decaying wood & thin soil over rock		OG	PISI	liverwort
Douinia ovata	S	wet coniferous forest	l,m	OG	conifer	liverwort

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Scientific Name	OC	Habitat	El	Seral Stage	Assoc. SP	Species Category
Elaphomyces sp. nov. #Trappe 1038	H	coastal OG legacy	l,m	mat-OG	TSHE,PISI,PSME	undescribed fungal taxa
Encalypta brevicola var. crumiana	S	shaded foggy rock	l,m	OG		bryophytes
Endogone oregonensis	D	coast & coast ranges	l	mat-OG	PISI,TSHE	rare Zygomycetes
Fayodia gracilipes	U	litter, humus or dead wood		LS	conifer	uncommon gilled mushrooms
Galerina atkinsoniana	U	moist; specific details lacking			mosses	moss dwelling mushrooms
Galerina cerina	U	moist; specific details lacking			mosses	moss dwelling mushrooms
Galerina heterocystis	U	moist; specific details lacking			mosses	moss dwelling mushrooms
Galerina sphagnicola	U	moist; specific details lacking			mosses	moss dwelling mushrooms
Galerina vittaeformis	U	moist; specific details lacking			mosses	moss dwelling mushrooms
Gastroboletus imbellus	S		u-m		pinaceae	rare boletes
Gastroboletus ruber	U	well developed humus layer		OG	TSME	rare boletes
Gastroboletes turbinatus	S	thick humus and abundant large coarse woody debris	l,m,h	OG	conifer	boletes
Gautieria otthii	R	ectomycorrhizal with Pinaceae	m,h	mat-OG	mixed conifer	rare false truffle
Glomus radiatum	S	moist coarse woody material	l,m,h	mat-OG	SESE, CHNO	rare Zygomycetes
Gomphus bonarii, B. clavatus, B. floccosus, B. kauffmanii	S	rich humus layer	l,m,h	OG	conifer	Chanterelles - Gomphus
	U					rare resupinates and polypores

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Scientific Name	OC	Habitat	El	Seral Stage	Assoc. SP	Species Category
Gymnopilus puntifolius	D	well decayed stumps and logs		LS	conifer	uncommon gilled mushroom
Gyromitra californica	U	decaying matter & rotten wood		mat		rare resupinates and polypore
Gyromitra esculenta	U	rotten wood		OG		rare resupinates and polypore
Gyromitra infula	S	decaying matter and rotten wood		mat		rare resupinates and polypore
Gyromitra melaleucoides	U	decaying matter and rotten wood				rare resupinates and polypore
Gyromitra montana (syn. G. gigas)	U	decaying matter & rotten wood		mat		rare resupinates and polypore
Hebeloma olympiana	U	habitat requirements not known				uncommon gilled mushrooms
Helvella compressa	S	riparian or wet	l,m	LS		rare cup fungi
Helvella crassitunicata	S	riparian or wet	l,m	LS		rare cup fungi
Helvella elastica	D	riparian or wet	l,m	LS		rare cup fungi
Helvella maculata	D		l,m	LS		rare cup fungi
Herbertus aduncus	S	foggy rocks and tree-trunks		OG		bryophytes
Herbertus sakurali	S	foggy rocks in forests		OG		bryophytes
Heterodermia sitchensis	U	unknown				additional lichen species
Hydnum repandum	D			LS	conifer and hardwood	tooth fungi
Hydnum umbilicatum	S			LS	conifer and hardwood	tooth fungi
Hydrothyria venosa	S	clear, cold streams	l,m	OG		aquatic lichen
	U	unknown				

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Scientific Name	OC	Habitat	El	Seral Stage	Assoc. SP	Species Category
Hygrophorus vernalis	U	habitat requirements not known				uncommon gilled mushrooms
Hypogymnia duplicata	R	foggy, coast & maritime sites	l		conifers	rare leafy (arboreal) lichens
Hypomyces luteovirens	U	fruit bodies of other fungi		LS		parasitic fungi
Iwatsukella leucotricha	S	bark		OG		bryophytes
Kurzia makinoana	S	shaded rotten wood &humic soil	l,m	OG		bryophytes
Leptogium burnetiae var.hirsutum	S	riparian forest on older trees	l,m	OG	hardwood	riparian lichens
Leptogium cyanescens	S	riparian forest on older trees	l,m	OG		riparian lichens
Leptogium rivale	S		l,m	OG		aquatic lichens
Leptogium saturninum	S	forests on older hardwood trees	l,m	OG		riparian lichens
Leptogium teretiusculum	H	riparian forest on old hardwoods	l,m	OG		riparian lichens
Leucogaster citrinus	S	abundant legacy of coarse debris	l,m	mat-OG	PSME,TSHE,CACH	rare false truffles
Leucogaster microsporus	S	abundant legacy of coarse debris	m	OG	PSME	rare false truffles
Lobaria linita	S		l	OG	PSME,ACMA,ALRU	rare nitrogen fixing lichens
Lobaria hallii	S	hardwoods/shrubs coastal forests	l,m	LS	conifers	rare nitrogen fixing lichens
Lobaria oregana	D	open coastal forests		OG	conifers	nitrogen fixing lichens
Lobaria pulmonaria	D	wet, hardwood forests swamps		OG		nitrogen fixing lichens
Lobaria scrobiculata	H			OG>140		nitrogen fixing lichens
Macowanites chlorinosmus	H	large coarse woody material	l	mat-OG	PISI, PSME, TSHE	uncommon false truffles

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Scientific Name	OC	Habitat	El	Seral Stage	Assoc. SP	Species Category
Microcalicium arenarium	S			OG		pin lichens
Mycena hudsoniana	U	litter, humus or dead wood		LS	conifer	uncommon gilled mushrooms
Mycena lilacifolia	U	rotting stumps and logs		LS	conifer	uncommon gilled mushrooms
Mycena marginell	U	rotting stumps and logs		LS	conifer	uncommon gilled mushrooms
Mycena monticola	U	litter, humus or dead wood		LS	conifer	uncommon gilled mushrooms
Mycena overholtsii	U	rotting stumps and logs		LS	conifer	uncommon gilled mushrooms
Mycena quinaultensis	U	litter, humus or dead wood		LS	conifer	uncommon gilled mushrooms
Mycena tenax	U	litter, humus or dead wood		LS	conifer	uncommon gilled mushrooms
Mycocalicium subtile	S			OG		pin lichens
Mythicomyces corneipes	U	litter, humus or dead wood		LS	conifer	uncommon gilled mushrooms
Neolentinus kauffmanii	S	only on logs or stumps of PISI		LS	PISI	uncommon gilled mushrooms
Neournula pouchetii	S	conifer litter			THUJA/TSUGA	rare cup fungi
Nephroma bellum	H	open forest		OG		nitrogen-fixing lichens
Nephroma helveticum	D	coast & montane forests		OG		nitrogen-fixing lichens
Nephroma isidiosum	U	unknown				additional lichen species
Nephroma laevigatum	D	coastal forests	l	OG		nitrogen-fixing lichens
Nephroma occultum	S			OG>400	conifers & deciduous	rare nitrogen-fixing lichen
	H	moist	l		conifers	nitrogen-fixing lichens

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Scientific Name	OC	Habitat	El	Seral Stage	Assoc. SP	Species Category
Octavianina papyracea	S	mesic	l	mat-OG	PISI, TSHE, PSME, SESE	rare false truffles
Otidea leporina	S	fog belt	l	LS	conifer	rare resupinates and polypore
Otidea onotica	D	duff in moist-wet forests	m,l	LS	conifer	rare resupinates and polypore
Otidea smithii	S	duff in moist-wet forests	m,l	LS	conifer	rare resupinates and polypore
Oxyporus nobilissimus	S	large stumps, snags, living trees;	m,l	OG	ABPR	noble polypore
Pannaria leucostictoides	H	open coastal forests	l	OG		nitrogen-fixing lichens
Pannaria mediterranea	S			OG>140		nitrogen-fixing lichens
Pannaria rubiginosa	S	bases of trees		mat		rare nitrogen-fixing lichens
Pannaria saubinetii	H			OG>140		nitrogen-fixing lichens
Peltigera pacifica	D			OG>140		nitrogen-fixing lichens
Peltigera collina	H	coast forests	l,m	OG		nitrogen-fixing lichens
Peltigera neckeri	H			OG>140		nitrogen-fixing lichens
Phaeocollybia ssp. (P. attenuata, P. fallax, P. sipei, P. olivacea have been documented)	D		l,m			Phaeocollybia
Phellodon atratum	H			LS	conifers / hardwoods	tooth fungi
Phlebia diffusa	U	wood, humus, litter			conifers	rare resupinates and polypores
Phlogoitis helvelloides	S	riparian zones/large woody debris			conifers	jelly mushroom
	S	litter, humus or dead wood		LS		uncommon gilled mushroom
	S	large woody debris in well lit forest altern.				mushroom lichen

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Scientific Name	OC	Habitat	El	Seral Stage	Assoc. SP	Species Category
Plagiochila satol	S	cliffs, rocks & conifer bark		OG	conifer	Bryophytes
Plagiochila semidecurrens var.crumniana	S	foggy cliffs, bark & shaded thin soil over rock		OG		Bryophytes
Platismatia lacunosa	S	moist forest	l,m	OG		riparian lichens
Plectania melastoma	U	forest duff		LS-OG	conifer	rare resupinates and polypores
Podostroma alutaceum	U	decayed wood fragments in duff		mat	conifer or mixed	rare resupinates and polypores
Polyozellus multiplex	S	along intermittent streams/seeps		mat-OG	Picea,Abies	rare Chanterelles
Polyporoletus sublividus	U	wood, humus, litter				rare resupinates and polypores
Postia rennyii	U	wood, humus, litter				rare resupinates and polypores
Pseudaleuria quinaultiana	S	wet	l	LS	conifer	rare cup fungi
Pseudocyphellaria anomala	D	coast forests	l,m	OG		nitrogen-fixing lichens
Pseudocyphellaria anthraspis	D	open forests	l,m	OG	conifer	nitrogen-fixing lichens
Pseudocyphellaria crocata	D	trunks		OG>140		nitrogen-fixing lichens
Pseudocyphellaria rainierensis	R	boles		OG>200	PSME	rare nitrogen-fixing lichens
Ptilium californicum	S			OG	conifers	Bryophytes
Racomitrium aquaticum	R	rocky streambanks(splash zone)		OG		Bryophytes
Ramalina pollinaria	S	coast forests on sandstone		mat-OG		additional lichen species
Ramaria sp.	D	litter, humus		mat-OG		coral fungi
Rhizopogon brunneiniger	S	dry to moderate	l,m,h	mat-OG	Pinaceae	rare false truffles

Appendix 4 - ROD Species Occurrence in the Benton Foothills Analysis Area

Occurrence information ,found in the column OC, was determined as follows:

Present (P): documented
Highly probable (H):
Suspected (S):
Remote possibility (R):
Unknown (U):

Elevation data, obtained from Appendix J-2 of the FSEIS, was determined to be:

l = below transient snow zone
m = transient snow zone
h = subalpine & alpine

Scientific Name	OC	Habitat	El	Seral Stage	Assoc. SP	Species Category
Rhizopogon flavofibrillosus	R		m	LS	Pinaceae	rare false truffles
Rhodocybe nitida	S	moist, deep humus & litter layer	l			rare gilled mushrooms
Rickenella setipes	U	moist; details of ecology lacking			mosses	moss dwelling mushroom
Russula mustelina	U	habitat requirements not known		LS		uncommon gilled mushrooms
Sarcodon fuscoindicum	S			LS	conifers / hardwoods	tooth fungi
Sarcodon imbricatus	S			LS	conifers / hardwoods	tooth fungi
Sarcosoma mexicana	D	coastal forests	m		conifers	rare resupinates and polypore
Sarcosphaera eximia	U	chalky soils (European strain)			conifers & fagaceae	rare resupinates and polypore
Scouleria marginata	S	splash zone of streams		OG		bryophytes
Scytinostroma cf. galatinum	U					rare resupinates and polypores
Sparassis crispa	D	base of large trees	l,m	LS	PSME	cauliflower mushroom
Spathularia flavida	U	duff layer		mat	conifer	rare resupinates and polypores
Stagnicola perplexa	U	litter, humus or dead wood		LS	conifer	uncommon gilled mushrooms
Stenocybe clavata	S	high atmospheric humidity		OG		pin lichens
Stenocybe major	S			OG		pin lichens
Sticta arctica	S	coast forest rock outcrops		OG		rare rock lichens
Sticta beauvoisii	S			OG>140		nitrogen-fixing lichens
Sticta fuliginosa	D	coast & moist forests	l	OG	conifer	nitrogen-fixing lichens

Appendix 4 - ROD Species Occurrence in the Benton Foothills Analysis Area

Occurrence information ,found in the column OC, was determined as follows:

Present (P): documented — Remote possibility (R):
Highly probable (H): — Unknown (U):
Suspected (S):

Elevation data, obtained from Appendix J-2 of the FSEIS, was determined to be:

l = below transient snow zone
m = transient snow zone
h = subalpine & alpine

Scientific Name	OC	Habitat	El	Seral Stage	Assoc. SP	Species Category
Thaxterogaster sp. nov. #Trappe 4867, 6242	P	coarse woody debris in fog belt	l,m	mat-OG	PISI, TSME, PSME	undescribed fungal taxa
Tholurna dissimilis	S	subalpine fog zone			TSME/ PSME	rare leafy (arboreal) lichens
Tricholoma venenatum	S	diverse OG-forests/heavy humus		LS	conifers	rare gilled mushrooms
Tritomaria exsectiformis	S	riparian moist shaded rocks	l,m,h	OG		Bryophytes
Tritomaria quinquedentata	S	moist shaded rocks	l,m,h	OG		Bryophytes
Tuber sp.nov.#Trappe 12493	S	coarse woody debris in fog belt	l,m	mat-OG	PISI, TSHE, PSME	undescribed fungal taxa
Tuber sp. nov. #Trappe 2302	S	coarse woody debris in fog belt	l,m	mat-OG	PISI, TSHE, PSME	undescribed fungal taxa
Tylopilus pseudoscaber	S	moist forest with coarse woody debris	l	OG	PISI	low elevation boletes

Appendix 5 - Riparian Reserve Slope Distance Adjustment for Mapping

Objective: Improve mapping to more realistically portray Riparian Reserves.

Approximate Average Topography Calculations by Subwatershed

C Used to adjust Riparian Reserves based on slope distance rather than horizontal distance as currently used in GIS data theme.

Beaver Creek:	25%
Hammer Creek:	30%
Oliver Creek:	32%
Moss Creek:	17%
Reese Creek:	22%
Upper Greasy Creek:	26%

Procedures:

* Only sampled slope measurements in areas on or proximal to BLM owned land and only where topography data was available in GIS.

* Measured slope for 500' on each side of the stream, at approximately 3,000' intervals along main stream channels and side channels >3,000' in length.

Appendix 6 - Fish Species of the Muddy Creek Watershed

Cheryl Hummon (July 1996)
Muddy Creek Biodiversity Team
Oregon State University

Codes: I = Introduced species
T = Federal Threatened Species under Endangered Species Act
C = Federal Candidate for Endangered Species Act
SS= Oregon Sensitive Species

	Scientific Name	Common Name	Codes
1	Lampetra richardsoni	western brook lamprey	
2	Lampetra tridentata	Pacific lamprey	C, SS
3	Cottus aleuticus	coast range sculpin	
4	Cottus asper	prickly sculpin	
5	Cottus beldingi	paiute sculpin	
6	Cottus gulosus	riffle sculpin	
7	Cottus perplexus	reticulate sculpin	
8	Cottus rhotheus	torrent sculpin	
9	Aciperser transmontanus	white sturgeon	
10	Alosa sapidissima	American shad	I
11	Oncorhynchus (Salmo) clarki	cutthroat trout	
12	Oncorhynchus mykiss	rainbow trout	
13	Oncorhynchus mykiss	redband trout	C, SS
14	Salmo trutta	brown trout	I
15	Prosopium williamsoni	mountain whitefish	
16	Acrocheilus alutaceus	chiselmouth	
17	Carassius auratus	goldfish	I
18	Cyprinus carpio	common carp	I
19	Mylocheilus caurinus	peamouth	
20	Notemigonus crysoleucas	gonden shiner	I
21	Pimephales promelas	fathead minnow	I
22	Ptychocheilus oregonensis	northern squawfish	
23	Ptychocheilus umpquae	Umpqua squawfish	
24	Rhinichthys cataractae	longnose dace	C,SS
25	Rhinichthys falcatus	leopard dace	
26	Rhinichthys osculus	speckled dace	T
27	Richardsonius balteatus	redside shiner	
28	Oregonichthys crameri	Oregon chub	C,SS
29	Catostomus macrocheilus	largescale sucker	
30	Catostomus platyrhynchus	mountain sucker	
31	Ictalurus (Ameiurus) natalis	yellow bullhead	I
32	Ictalurus (Ameiurus) nebulosus	brown bullhead	I
33	Ictalurus punctatus	channel catfish	I
34	Percopsis transmontana	sand roller	
35	Funduls diaphanus	banded killifish	I
36	Gambusia affinis	western mosquitofish	I
37	Gasterosteus aculeatus	threespine stickleback	
38	Lepomis cyanellus	green sunfish	I
39	Lepomis gibbosus	pumpkinseed	I
40	Lepomis (Chaenobrytlus) gulosus	warmouth	I
41	Lepomis macrochirus	bluegill	I
42	Micropterus dolomieui	smallmouth bass	I
43	Micropterus salmoides	largemouth bass	I
44	Pomoxis annularis	white crappie	I
45	Pomoxis nigromaculatus	black crappie	I
46	Perca flavescens	yellow perch	I
47	Stizostedion vitreum	walleye	I
48	Cymatogaster aggregata	shiner perch	

APPENDIX 8- Riparian Reserve Project Design--Factors to Consider

- Management objectives for the site should be based on the physical and biological potential, and the geomorphic context of the site. The geomorphic context should be field investigated and an explanation of its significance to the site's physical and biological processes should be addressed in the EA. This description should include an estimate of the extent of true riparian zone (i.e., the stream adjacent zone that directly influences conditions in the aquatic environment) as distinguished from the uplands that lie within the Riparian Reserve area.

  Factors to consider when distinguishing the uplands from the true riparian include:

  - Slope breaks--that point on the slope where erosional processes have produced an oversteepended and actively eroding surface that contributes sediment directly to the channel and/or flood plain
  - Geomorphic type--flood plains, terraces, alluvial-colluvial fans, debris torrents, in-channel landslide deposits, stream banks and vertical canyon walls ("gorges") are all considered actively and directly influencing aquatic conditions, and therefore part of an ecological riparian zone while a stable colluvial hillslope, bench or ridge line is considered upland
  - Water table--as evidenced by plant communities and physical conditions at the site
  - Stream channel type--steep, intermittent "source" stream, or low gradient depositional reach

- Upland sites within the riparian reserve allocations are transitional and their direct influence on aquatic conditions quickly approaches a limit where management activities carry small potential, or risk, for the aquatic system. How quickly this limit is approached varies by issue (i.e.,stream temperature vs. sediment supply) as well as spatially and temporally. This should be recognized in project planning by addressing these specific effects at the project level.

- Since standards and guidelines for a properly functioning riparian zone have not been well quantified, we need to develop our own on a site specific basis. For the true riparian zone we should identify reference sites that can serve as a model for how we think the site in question should or could function. This would help define the "range of natural variability" for the site. Where no adequate reference site can be identified, we rely on "professional judgement" backed up by whatever research and reference work we can locate together with evidence from the site in question.

- Treatment prescriptions should include all subsequent treatments necessary to achieve older forest characteristics, ACS objectives and coarse woody debris (CWD) goals for the stand. Monitoring needs to be specifically identified to insure that it is completed and the results carried on into future planning.

- Major riparian vegetation functions which need to be addressed when assessing project level conditions are found in the table on the page following.

RIPARIAN RESERVE FUNCTIONS AND THE ROLE OF VEGETATION

Riparian Vegetation Function	Requirements for Proper Function
Shade C regulates instream temperatures for fish/amphibians/invertebrates C regulates terrestrial microclimate	C large trees and other vegetation with high % canopy closure
Allochthonous input C food resource for invertebrates/microbes (99% in first order streams)	C diverse species of trees and other vegetation
Large woody debris source C provides habitat for fish, amphibians, invertebrates, beaver, fungi, and bryophytes C helps frame stream channel morphology	C mature and understory conifers in abundant supply and well distributed
Nutrient/sediment filter C maintains high water quality	C periodic inundation of flood plain provided by connectivity of flood plain and stream (promotes denitrification) C trees and other vegetation to trap sediment
Habitat/Dispersal corridors C provides cover, forage, water C provides connectivity to dispersal areas within and between watersheds	C mature to late-successional forest characteristics
Bank stability C lowers erosion potential C maintains high water quality	C trees and other vegetation with good root strength
Energy dissipation C lowers erosion potential C builds flood plains C maintains high water quality	C Large woody debris in channel and on flood plain C streamside trees and other vegetation C connectivity of stream and flood plain (flood plain inundated every 1-3 years)

Appendix 9 - Prioritized List of Proposed Road Improvements

The following is a prioritized list of road improvements which would have the greatest potential for reducing soil displacement and sediment in streams. All replacement pipes will be sized to meet 100-year flood criteria. See Map 20 for geographic locations.

1) Road No. 13-6-20: Replace a total of five failing culverts. Of the five, three are on intermittent and one on perennial streams.

2) Road Designation 4D: Rock 0.26 mile of the shortcut road to eliminate the serious soil displacement problem.

3) Road No. 13-6-19: Rock approximately 0.42 mile of native surfaced road to eliminate rutting. All other segments of this tie through route are rocked. The road is used year-round.

4) Road No. 13-6-32: Replace the inadequately sized 18-inch diameter culvert with 30-inch diameter. Rock stream crossing approaches to reduce sediment into the Reese Creek perennial tributary. Also, place (foundation class) pitrun at a site where a spring outlets from the unsurfaced roadbed. Blade out the wheel-ruts and outslope the running surface.

5) Road No. 13-6-21.3: Replace a failing culvert on a perennial stream.

6) Road No. 13-6-21.1: Replace a failing culvert on an intermittent stream.

7) Road No. 13-6-21.2: Replace a failing culvert on an intermittent stream.

8) Road No. 14-6-17: Armor the deeply scoured ditch line and replace a failing 24-inch diameter culvert.

9) Road No. 13-6-27: Boost the insufficient rock depth on the first 0.20 mile of road surface and place the initial lift of rock on the subsequent 0.35 mile.

10) Road No. 13-6-19.7: Either rock or construct surface drainage structures (armored draindips) on 0.42 mile of native surfaced road to eliminate rutting.

11) Road No. 13-6-19.8: Rock approximately 0.18 mile of native surfaced road to reduce the potential for sediment into a perennial tributary of Gleason Creek.

12) Road No. 14-6-17.1: Install additional cross-drain culverts on 0.67 miles of steep road grade.

Appendix 10 - Prioritized List of Roads for Potential Closure

Road No.	Miles	Method	Remarks
13-6-15	0.54	Obliterate	Natural surfaced road is located within the Duffy Creek Riparian and is unnecessary for future management. Remove two failing log drainage structures, restore to natural streambed, and obliterate and grass seed the roadbed.
7D	0.22	Earthberm	Steep graded, natural surfaced shortcut spur with rutting. Construct reinforced surface drainage structures prior to closure.
13-6-27	0.47	Earthberm/ Obliterate	Block steep graded, natural surfaced road segment after improving surface drainage. Remove two failing log drainage structures on a Starr Creek tributary, restore the creek to its natural streambed, and obliterate and seed the road in the proximity.
13-6-29.1	0.50	Earthberm	Steep graded, natural surfaced road with severe wheel rutting. Construct reinforced surface drainage structures prior to closure. At least a portion of the road will be needed for future management and will likely be upgraded at that time.
13-6-28	1.00	Earthberm	Steep graded, natural surfaced road with rutting. Construct reinforced surface drainage structures prior to closure.
13-6-32	2.48	Earthberm	Block access to 4x4 OHV use to eliminate primary rutting source. Improve surface drainage prior to closure (as described in Appendix 9 -- Proposed Road Improvements).
13-6-21.3	0.21	Obliterate	Remove failing 24-inch diameter culvert buried beneath a 20-foot high fill on a perennial stream prior to closure. The road currently ends within the riparian zone of a Beaver Creek tributary.
1A	0.20	Earthberm	Steep graded, natural surfaced road is a sediment source to Duffy Creek. Construct reinforced surface drainage structures prior to closure.
7E	0.24	Earthberm	Block native surfaced railroad grade. May be used in the future for tractor logging access.
M6	0.35	Earthberm	Block native surfaced spur from 4x4 OHV use.
13-6-19.1	0.40	Earthberm	Steep graded, natural surfaced spur is now used exclusively by motorcycles. Eliminate potential 4x4 OHV damage.
13-6-19.3	0.40	Earthberm	Steep graded, natural surfaced spur is now used exclusively by motorcycles. Eliminate potential 4x4 OHV damage.
13-6-25	0.62	Obliterate	Restore the intermittent stream to its natural streambed and rip and seed the roadbed.
13-6-21.6	0.44	Earthberm	Steep graded, natural surfaced spur with substantial wheel ruts. Construct reinforced surface drainage structures prior to closure.
13-6-7.7	0.50	Earthberm	Restrict access on steep road grades. Next use for management purposes is decades away.

See Map 20 for geographic locations of the proposed road closures.

Appendix 11 - Benton Foothills Information Pamphlet

(location map not included)

Benton Foothills Watershed Analysis

The Salem District, Marys Peak Resource Area, is conducting an analysis of the Benton Foothills Watershed. We are interested in public issues and comments that pertain to this particular watershed. Your involvement is an integral step in the watershed analysis process.

WHAT IS WATERSHED ANALYSIS?

Watershed analysis is a procedure for collecting and examining information about the natural resources and human uses in an area. An end result of the analysis is a better understanding of the key ecological features, conditions, functions and interactions within the watershed. The end product is a report to federal land managers with management recommendations that are responsive to watershed processes and conditions identified in the analysis.

Analysis considers resource conditions in the entire watershed, regardless of land ownership or jurisdictional boundaries. Management recommendations for federally managed lands are based on ecosystem conditions and objectives of other landowners. The watershed analysis process is not intended, nor will it be used to dictate, influence, or judge management direction on non-federal lands. Our ultimate goal is to work collaboratively with others in the watershed to ensure the continued health of the forest ecosystem along with achieving management objectives outlined in the *Salem District Resource Management Plan (RMP)*.

ABOUT THE WATERSHED.

The Benton Foothills watershed analysis area, located in the Upper Willamette River Basin, encompasses about 80,647 acres of the southern Coast Range foothills of Benton County. The streams in the analysis area flow into Muddy Creek, Greasy Creek, and then to Marys River. About 8% of the analysis area (6,149 acres) is under BLM management. William L. Finley National Wildlife Refuge totals 5,325 acres, and the remaining land is in private ownership.

The towns of Bellfountain and Alpine are located within the watershed boundaries.

Management objectives for BLM land in the watershed are:

Late-successional Reserves (LSR) protect and enhance late-successional forest structure. About 376 acres of the watershed are designated as LSR.

Matrix manage for sustainable forest commodities with provisions to retain some large green trees, snags, and large downed wood. About 5,773 acres are designated Matrix in the watershed.

Riparian Reserves protect the health of the aquatic and riparian system and dependent species.

WE NEED YOUR HELP.

People who live in or frequently use an area often have an intimate knowledge and understanding of that environment. If you'd be willing to share your knowledge of this watershed with us, we would like to hear from you. Right now, the types of information we're looking for include:

Historical:
- How was the watershed used in the past? information from early settlement or family histories?
- Where were the early homesteads, farming, grazing?
- Where did logging occur? How was it done?
- How was the fishing? Hunting? How has it changed?

Present Concerns
- What are your most important issues in this watershed?
- What is unique, unusual, special about this watershed? Do you have any recommendations about these places?
- Are there particular roads you're concerned about? Why?
- Are there wildlife species you're concerned about? Why?

TALK TO OUR TEAM.

If you have information to share, please contact any of the following people or mail us the attached form.

Belle Verbics, Team Lead	315-5984	Effie Frazier, Fisheries Biologist	315-5964
Tom Tomczyk, Fire Ecologist	315-5965	Garth Ross, Wildlife Biologist	315-5949
Amy Haynes, Aquatic Biologist	315-5955	Steve Cyrus, Road Engineer	315-5988
Patrick Hawe, Hydrologist	315-5974	Bill Caldwell, Silviculturist	315-5961
Ron Exeter, Botanist	315-5963	David Haney, GIS Specialist	315-5977
Bob Saunders, Recreation	315-5978	Linda Conley, Forester	315-5979
Roger Monthey, Forest Ecologist	315-5971	Julie Fulkerson, USFW	231-6179
Bill Power, Soil Scientist	315-5970		

ARE YOU INTERESTED?

NAME:____

ADDRESS:____

CITY:____________________________ STATE:____________ ZIP:_____________

Please check all boxes that apply.

9 YES, I am interested in the analysis and would like to remain on your mailing list.

9 PLEASE contact me, I would like to talk with you further about the analysis.
The best way to contact me is__________________________________.

9 ADD me to your mailing list. .

__________________________*fold here*____

ISSUES? IDEAS? INFORMATION? CONCERNS?

Let us know your thoughts! Please be specific about geographic areas of concern and how they should be managed.

____

________________________________*fold back here*____

Stamp

Bureau of Land Management
Attn: Belle Verbics
Salem District Office
1717 Fabry road SE
Salem, OR 97306

Appendix 12 - Public Comments

Comments to the initial pamphlet for the Benton Foothills Watershed Analysis

1. Your map indicates only Muddy Creek drainage and not Greasy Creek, which includes USFS lands. For what purposes are drainages included and excluded in such analyses? Please document your decision criteria or correct your map or wording.

2. Depending on the larger vs. smaller analysis areas, what acreages do you calculate are in LSR and how many acres and what percent of the LSR is in late successional vegetatvie cover?

3. How much of the matrix land is in vegetative cover of late successional type and what percentage is planned to be harvested in the following year, the next decade and within the planning vision of the management process (usually 50 years)?

4. A number of historic sites, particularly tied to the logging industry may be found in this watershed (wooden and steel railroad beds, ponds and water sources, antique and/or relic logging equiptment). How will you evaluate and protect such cultural resources?

Answers to the above questions are results from the analysis.

5. I recently attended a meeting at which Dr. Stan Gregory (OSU) spoke about Willamette River ecology. I am interested in seeing how this analysis fits into the larger picture which he described.

6. I live on McCain Road, bordered by Weyerhauser land on three sides. I am concerned aobut several issues:

   1. I have another 5 acres parcel on Foster and Larkin. We have drilled 3 wells on that land which were all dry. The water table in the area is dropping as I can tell from my years of experience here.

   2. Where we live now, we have a shallow well which runs dry every year (it didn't used to).

   3. Weyerhauser sprays a lot of Atrazine above us in our watershed. Are we getting it?

   4. Development in our area is messing up the drainage that was here before. Now people build on wetland and our roads flood.

   5. All the local trout are disappearing.

BLM responded with a personal telephone call.

Appendix 13 -
Benton Foothills Watershed Mailing List

update 6-18-97

Oregon Department of Environmental Quality
Langdon Marsh, Director
811 SW Sixth Ave.
Portland, OR 97204

Oregon Department of Fish and Wildlife
Rudy Rosen, Director
P.O. Box 59
Portland, OR 97207

Oregon Department of Fish and Wildlife
Steve Mamoyac
7118 NE Vandenberg Ave.
Corvallis, OR 97330-9446

Oregon Department of Fish and Wildlife
Gary Galovich
7118 NE Vandenberg Ave.
Corvallis, OR 97330-9446

Oregon Department of Forestry
24583 Alsea Hwy.
Philomath, OR 97370

Oregon Department of Forestry
Jim Brown, State Forester
2600 State St.
Salem, OR 97310

Oregon Department of Land Conservation and Development
Dick Benner, Director
1175 Court St. N.E.
Salem, OR 97310

Oregon Division of State Lands
Paul Cleary, Director
775 Summer St. N.E.
Salem, OR 97310

Oregon Water Resources Department
Martha Pagel, Director
The Commerce Bldg.
Salem, OR 97310

Governor's Natural Resource Office
Ken Bierly, Watershed Coordinator
Governor's Office
Salem, OR 97301

Oregon Department of Agriculture
Bruce Andrews, Director
635 Capitol St. N.E.
Salem, OR 97310

Oregon Parks and Recreation Department
Bob Meiner, Director
1115 Commercial St. N.E.
Salem, OR 97310

Oregon Coastal Zone Management Assn.
Onno Husing
P.O. Box 1033
Newport, OR 97365

Oregon Natural Resources Council
1551 Oak St., Suite A
Eugene, OR 97401

Pacific Rivers Council
P.O. Box 10798
Eugene, OR 97405

Coast Range Association
P.O. Box 2189
Corvallis, OR 97339

Associated Oregon Loggers, Inc.
P.O. Box 12339
1127 25th St. S.E.
Salem, OR 97309-0339

Association of Northwest Steelheaders
P.O. Box 3341
Salem, OR 97302
Audubon Society

Jim Fairchild
31540 Homestead Rd.
Philomath, OR 97370

Audubon Society of Salem
189 Liberty St., N.E.
Suite 209-A
Salem, OR 97301-3529

Cathedral Forest Action Group
39599 Ward Rd.
Monmouth, OR 97361

CH2M Hill
P.O. Box 428
Corvallis, OR 97339

Native Plant Society of Oregon
PO Box 902
Eugene, OR 97440

Nature Conservancy
821 SE 14th Avenue
Portland, OR 97214

National Wildlife Federation
921 S.W. Morrison, Suite 512
Portland, OR 97205

Oregon Forest Industries Council
1149 Court St. NE
Salem OR 97309

Oregon Clean Water Coalition
PO Box 2277
Corvallis, OR 97339

Seneca Sawmill Company
PO Box 851
Eugene, OR 97401

Rosboro Lumber Company
PO Box 20
Springfield, OR 97477

Willamette Industries, Inc.
PO Box 907
Albany, OR 97321

Swanson Superior Forest Products
Dick Rohl
PO Box 459
Noti, OR 97461

Hull-Oakes Lumber Company
Ralph Hull, Don Oakes
PO Box 48
Monroe, OR 97456

Starker Forests, Inc.
Gary Blanchard
PO Box 809
Corvallis, OR 97339

Weyerhauser Company
Pam Whyte
PO Box 275
Springfield, OR 97477

U.S. Fish and Wildlife Service
Julie Fulkerson
2600 S.E. 98th Ave., Suite 100
Portland, OR 97226

U.S. Fish and Wildlife Service
Kathryn Barry
2600 S.E. 98th Ave., Suite 100
Portland, OR 97266-1398

U.S. Fish and Wildlife Service
Refuge Manager
26208 Finley Refuge Rd.
Corvallis, OR 97333

National Marine Fisheries Service
Garwin Yip
525 N.E. Oregon St., No. 500
Portland, OR 97232

Confederated Tribes of Grande Ronde
Mark Mercier, Tribal Chair
P.O. Box 38
Grande Ronde, OR 97347

Confederated Tribes of Grande Ronde
Cliff Adams
P.O. Box 38
Grande Ronde, OR 97347

Confederated Tribes of Siletz Indians
Delores Pigsley, Tribal Chair
P.O. Box 549
Siletz, OR 97380

Confederated Tribes of Siletz Indians
Mike Kennedy
P.O. Box 549
Siletz, OR 97380

Bureau of Indian Affairs
Gary Varner
P.O. Box 569
Siletz, OR 97380

Cascade Pacific Resources Conservation
and Development
3415 N.E. Granger Ave.
Corvallis, OR 97330

Ed Alverson
858 Pearl St.
Eugene, OR 97402

USFS Siuslaw National Forest
Jon Martin
P.O. Box 1148
Corvallis, OR 97330

Siuslaw Timber Operators Association
P.O. Box 309
Noti, OR 97461-0309

Benton County Board of Commissioners
Pam Folts, Chair
Benton County Courthouse
120 N.W. Fourth
Corvallis, OR 97330

Benton County Development Dept.
Jim Hope
360 S.W. Avery Avenue
Corvallis, OR 97333

Benton Soil and Water Conservation District
PO Box 1541
Corvallis, OR 97339-1541

Benton County Environmental Health
Ron Smith
530 N.W. 27th
Corvallis, OR 97330

US Forest Service
Alsea Ranger District
18591 Alsea Hwy.
Alsea, OR 97324

USDA - NRCS
Jim Heuker
33630 McFarland Rd.
Tangent, OR 97389

Environmental Protection Agency
811 SW Sixth Avenue
Portland, OR 97204

George Ice
National Council of the Paper Industry for
Air and Stream Improvement, Inc.
PO Box 458
Corvallis, OR 97339

Andrew Gray
Forestry Sciences Lab
3200 West Jefferson
Corvallis, OR 97331

Mathew Fillmore
Corvallis Soil Survey Office
USDA - NRCS
OSU - Dept. of Crop and Soil Science
ALS Bldg. - Room 3017
Corvallis, OR 97331-7306

Valley View Tree Ranch
24274 Neuman Road
Corvallis, OR 97333-9311

Thompson Tree Farm, Inc.
6860 SW Winding Way
Corvallis, OR 97333

Lowther Land & Timber LTD
2709 Chapel Drive
Corvallis, OR 97333-9549

Robert & Gene Brown
PO Box 204
Corvallis, OR 97339-0204

Charles Mark & Elaine Lynch
30722 Botkin Road
Philomath, OR 97370-9105

Terry & Joann McMackin
30874 Botkin Road
Philomath, OR 97379-9105

S. Vernon & Helen Sinclair
30846 Botkin Road
Philomath, OR 97370-9105

Bernard & Elva Delosky
PO Box 1146
Philomath, OR 97370-0791

Ms. Dorothy Angevine
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Maps Packet - Benton Foothills Analysis Area

Number	*Title*
1.	Land Use Allocation (LUA) / Riparian Reserves
2.	Ownership
3.	Digital Elevation Model
4.	Historical Vegetation 1850
5.	Vegetation
6.	Riparian with Seral Stages
7.	Federal Riparian Reserve / Forest Practices Act Stream Buffers
8.	Riparian Connectivity
9.	Stream Temperature / Bank Vegetation Shade
10.	Large Woody Debris Potential in Streams
11.	Snow Zone / Slope Hazard
12.	Channel Classification
13.	Off-Highway Vehicle (OHV) Trails
14.	Resident / Anadromous Fish
15.	Timber Harvest Opportunities
16.	Additional Regeneration Harvest (2005)
17.	Rural Interface Area
18.	Visual Resource Management Classification
19.	Slope Stability
20.	Road Closures and Improvements